The FOUNDRY

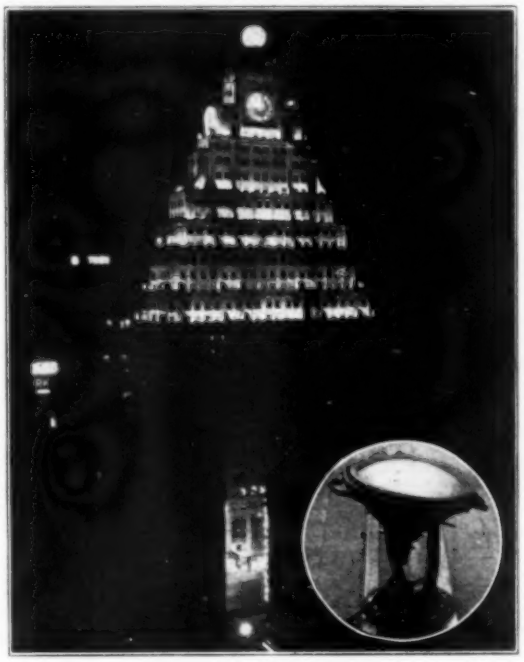
Volume 55
Number 16

Published
Semimonthly

CLEVELAND, OHIO, AUGUST 15, 1927

Castings Transform Darkness

EIGHTY thousand fight fans packed the Yankee stadium last month and watched ex-champion Dempsey stage his comeback. Due to progress that has been made by illuminating engineers, the customers were able to see without difficulty the movements



Floodlights Accentuate the Set Back Feature of the New Paramount Building in New York

of the three men within the ring. Applications of flood lighting continually are expanding. Each night the transcontinental air mail arrives and departs in perfect safety at the various well lighted ports scattered across the continent. Outdoor construction work now may be speeded since flood lights permit the work to be continued throughout the night. Stately buildings, monuments and scenes of natural beauty, bathed in light against the surrounding darkness, nightly command attention and admiration. Castings are used in the design of flood lights for the pedestal base and the rim which surrounds the cover glass. The housing for some types of flood lights, designed to withstand the weather, are cast aluminum.

Find Where Castings Can Be Sold.

CONTENTS

SPECIAL FEATURES

	Page
Preheating Reduces Melting Period—By Edwin Bremer	626
Heat Treating Definitions Approved by Technical Societies	631
Sodium Carbonate Compounds Affect Refractory Linings—By George S. Evans	632
Stepping Up Production Mechanically—III—By Pat Dwyer	635
Explains Brass Metallurgy—II—By Edmund R. Thews	639
Humid Oven Atmosphere Eliminates Surface Cracks—By George Wright and J. M. Sampson	644
Stops Crack in Monel Casting—By R. J. Walker	647
Casts Large Pipe Centrifugally—By J. E. Hurst	649
Numbering Patterns Simply Saves Time—By F. J. Cook	653
Bill Decides To Cut Out Long Words—By Pat Dwyer	655

REGULAR DEPARTMENTS

How and Why in Brass Founding — By Charles Vickers	643
What Others Are Thinking	658
Family Photograph Album	659
The Shakeout	660
Trade Trends in Tabloid	661
Comings and Goings of Foundrymen	662
Foundry Association Directory	663
What the Foundries Are Doing	666

—▫—

PUBLISHED BY THE PENTON PUBLISHING CO., CLEVELAND, O.
BRANCH OFFICES

BOSTON ..... 475 Main Street
CHICAGO ..... 1747 People's Gas Bldg.
CINCINNATI ..... 209 Edwards Bldg.
NEW YORK ..... 2208-2206 No. 220 Broadway
PITTSBURGH ..... 2148-4? Oliver Bldg.
SAN FRANCISCO ..... 24 California Street
WASHINGTON, D. C. ..... 1663 Pennsylvania Avenue
BIRMINGHAM, ENGLAND ..... Prince's Chambers
LONDON, ENGLAND ..... 2-3 Caxton House, Westminster, S. W. 1
PARIS, FRANCE ..... No. 9 Rue de Londres
BERLIN, GERMANY ..... Friedrichstrasse 218, S.W. 48

Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico ..... $3.00 a year
Canada ..... $4.00 a year
Great Britain and other Foreign Countries ..... £1:0:0 a year
Single copies ..... 25 cents

Copies published three months or more previous to date of current issue, 50 cents each

Member, Audit Bureau of Circulations, Associated Business Papers Inc., National Publishers Association

The A. B. P. is a nonprofit organization whose members have pledged themselves to a working code of practice in which the interests of the men of American industry, trade and professions are placed first—a code demanding unbiased editorial pages, classified and verified paid subscribers, and honest advertising of dependable products

Copyright 1927 by the Penton Publishing Co.

Preheating R

By Edwin Bremer

THIS is the first of two articles describing one of the modern electric steel foundries. The second will appear in an early issue of THE FOUNDRY.

Fig. 1—After the Steel Is Melted, the Turntable Is Given a Half Rotation Which Brings the Furnace to the Pouring Pit Where the Contents are Poured Into a 4-Ton Teapot Spout Ladle

IRON and steel have played an important part in the advancement of the human race since the beginning of history. Iron is mentioned in the Old Testament. Ancient Egyptians were familiar with the metal at least 4000 years ago. From the traces of Assyrian civilization there is no doubt that they understood its production and made implements of it.

Metal was produced on crude hearths and the necessary air blast was supplied by hand bellows. Charcoal was used for fuel and the iron was obtained in small pieces which were sold to gold and silver smiths who refined it further. Large pieces of metal were formed by welding and forging the smaller pieces into greater masses.

Later it was found that the soft wrought product acquired different properties when heated for some time in contact with charcoal. This product was known as cemented or blister steel.

In 1740 Robert Huntsman, an English clock-

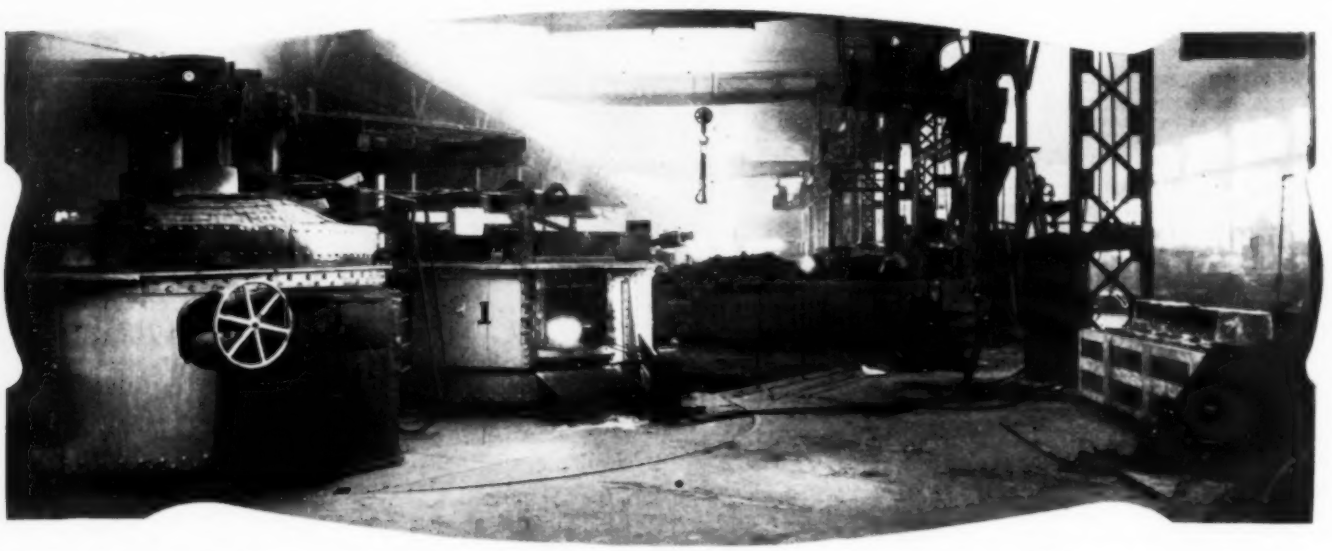


Fig. 2—As Soon as the Furnace Has Been Charged and the Roof Replaced, an Oil Burner Placed in the Door Preheats the Metal

Reduces Melting Period

maker, discovered how to manufacture crucible steel. No doubt, his experiments along this line were the result of dissatisfaction with the inferior, un-uniform steel which was supplied for clock springs.

An American, William Kelly, in 1846 and later in 1856, Henry Bessemer, an Englishman, each unknown to the other, discovered the method of producing steel in the converter.

Siemens developed his gas producer with the regenerator principle which was used for obtaining high temperatures on the hearth, but it was used principally in glass working. The gas producer was unsuccessful in steelmaking until 1868 when the Martin brothers, Frenchmen, overcame difficulties and developed the open-hearth steel process, using pig iron and scrap in the charge. This process still is known on the Continent as the Siemens-Martin process, but in this country simply as the open-hearth process.

Previous to 1878 all steel produced was made on the acid hearth. At this time Thomas and Gilchrist found that a basic lining and a basic slag could be used in the bessemer converter and developed what is known as the basic bessemer process.

Some experimental work on the use of electricity for a heating agent had been done from time to time, but it was not until 1853 that Pichon took out a patent for the first electrothermic furnace. In 1878-79 William von Siemens obtained an English patent for an electric furnace.

More and more interest was taken in the application of electricity industrially and in 1887-88 Heroult developed a furnace for the production of aluminum. In 1894 he successfully used his electric furnace for making calcium carbide.

Even though considerable development of the electric furnace had taken place, the iron and steel makers refused to be interested. However, in 1898 Stassano obtained a patent for an electric furnace—the first for the production of iron—and included the following in his claims: "A method for the practical production of liquid wrought iron in any degree of carbon and of liquid alloys of iron by the electric current."

Heroult obtained a patent for his steel furnace in 1899-1900 and about the same time Kjellin patented his induction furnace. However, due to the high cost of electricity, the electric furnace only could be employed near waterfalls. Fortunately, shortly after this period new methods for generating electricity and further improvement in prime movers for this equipment were developed. Inland plants, independent of waterfalls, were established and in 1905 a heroult furnace for the production of steel was put into operation at Remscheid, Germany.

Shortly after, in 1906, the first electric furnace devoted to the production of steel castings was employed in this country. Germany led the world in the production of electric steel castings for many years, but in 1917 the United States attained the leadership and continues to hold it.

Fig. 3.—View of the West Foundry Bay. The Foundry Offices Are in the Rear

From the initial installation of one electric furnace for producing steel castings in 1906, the use of these furnaces has increased enormously and at the present time the total tonnage of electric-steel castings produced is equal to one-third that of open hearth steel castings. At first the electric steel furnace was heralded as the panacea for all the ills of steel casting. However, it soon was found that expert supervision is just as necessary in making electric steel as in producing steel by any of the other known processes.

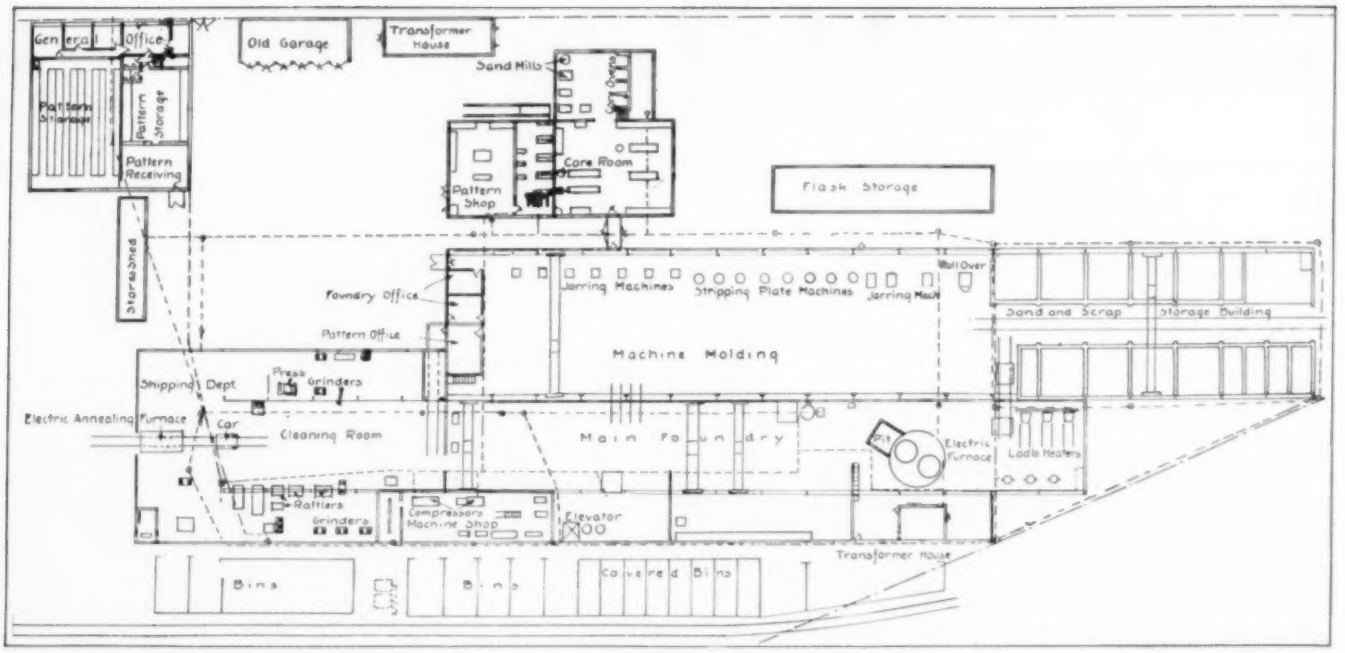


Fig. 4—Plan of the Burnside Steel Foundry Co. Showing the Arrangement of the Buildings and Foundry Equipment

The measure of success in any modern steel foundry, employing the electric furnace, is provided by studying the technique which has been developed in the various necessary processes, in control of the melting units and in handling the product from raw material to the finished casting. A successful electric steel foundry of the middle west measures well up on such a scale, as will be found from a study of the details presented in this and a succeeding article. The Burnside Steel Foundry Co., Chicago, operating the plant in question, has taken full account of the modern idea of regular sequence of operations. As may be seen in Fig. 4, the plant extends north and south with the scrap storage bins and electric furnaces at the north end. Then follow the molding floors, the cleaning room, welding and annealing departments, and the shipping department practically following the order named.

The general office and pattern storage, coreroom and pattern shop, and the flask storage departments are housed in separate buildings close by on the west. The coreroom has a covered passage connecting it to the foundry building. The west foundry bay is 250 feet long and 62 feet wide. The east bay is 270 feet long and 40 feet wide. Forty feet of the south end of this bay is given over to part of the cleaning room. The remainder of the cleaning room and shipping department are housed in a low-roofed structure 110 feet long and 80 feet wide. The sand and scrap storage building attached to the north end of the west bay is 145 feet long and 62 feet wide.

The sand and scrap bins are constructed of reinforced concrete and placed on each side of the building with a standard-gage, railroad track between. The bins are 20 feet high and 25 feet wide. An excellent idea of their placement and size may be

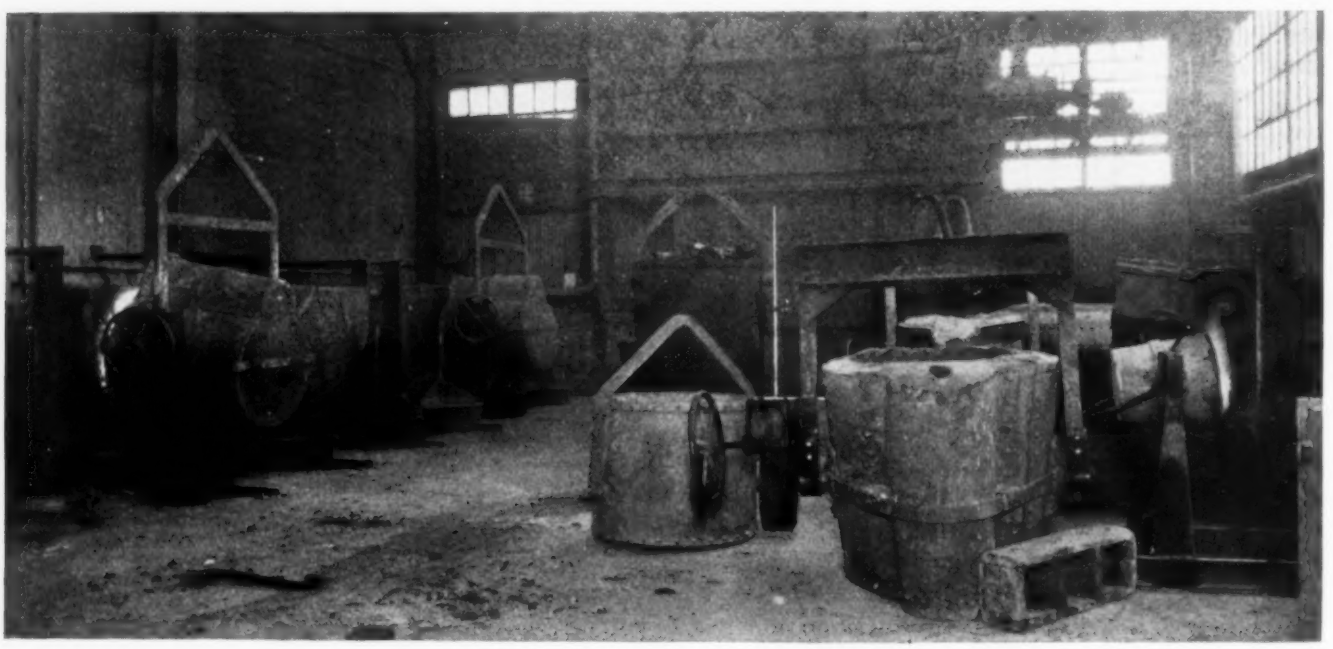


Fig. 5—A Portion of the East Bay Behind the Electric Furnaces Is Devoted to Ladle Drying and Heating Devices

obtained from Fig. 6. A 6-ton, 60-foot span crane manufactured by the Northern Engineering Works, Detroit, spans the bins and is used with a magnet or bucket for transporting materials into or out of the bins.

At the right side of Fig. 6 a track may be seen. A car moving on this track is used for transporting scrap, sand, etc., to the electric furnaces.

The west foundry bay is devoted to machine molding and contains machines of various sizes and manufacture. The larger castings are made on a roll-over molding machine and a jolt machine manufactured by the Davenport Molding Machine Co., and now made by The Milwaukee Foundry Equipment Co., Milwaukee, and 2 jolt machines manufactured by the Osborn Mfg. Co., Cleveland. Ramming larger molds is accomplished with pneumatic rammers manufactured by the Chicago Pneumatic Tool Co., New York. Smaller castings are molded on 8 stripping plate machines manufactured by the William H. Nicholls Co., Inc., Brooklyn, N. Y., and 6 jolt and squeezer machines manufactured by the Osborn Mfg. Co., Cleveland.

A 6-ton, 60-foot span crane is used in the west foundry bay for transportation purposes. At the south end of this bay are located the pattern office where the patterns in production are checked into and out of the foundry, and the foundry offices where the various details of foundry operations are supervised. Fig. 3 is a view of the west bay taken approximately from the center. On the right may be seen the steel-sash window construction which gives ample light. The foundry office and pattern office are in the rear. The Burnside Steel Foundry Co. has a stock of about 5000 steel flasks of various sizes. About 3500 of these were manufactured by the Truscon Steel Co., Youngstown, Ohio, and the remainder are of the Burnside company's own manufacture. These consist of cast steel ends made in its own foundry with steel channels riveted on, to form the sides. Some of these flasks are shown in the foreground of Fig. 3. Just outside the west foundry bay is a low roofed building, constructed of corrugated sheet steel which is used for flask storage. This building is about 25 x 100 and all flasks not in use are stored in it. By doing this the foundry is kept clear of equipment not in use, and the flasks are under cover, which prevents rusting or other deterioration.

The east bay contains the ladle drying equipment, electric furnaces, facing sand mill, bench molding shop, heavy molding floors, machine shop and part of the cleaning room. A continuation of this bay, as previously mentioned, contains the remainder of the cleaning room, arc welding machines, electric annealing furnace, grinding machines and shipping department. To maintain a semblance of orderly continuity the reader will begin at the north end of the bay containing the ladle drying equipment and follow through to the shipping room at the south end.

Fig. 6—Large Reinforced Concrete Bins Give Ample Storage Room for Scrap, Sand, Clay and Other Materials

An idea of the arrangement of the large ladle drying devices may be gained, from Fig. 5. On the left a 4-ton ladle is being dried. The apparatus consists of a large, square, steel frame filled with fire brick. In the center an opening is left through which an oil burner manufactured by the Hauck Mfg. Co., Brooklyn, N. Y., injects its flame. Air pressure for this burner is supplied by a rotary blower manufactured by the P. H. & F. M. Roots Co., Connersville, Ind.

Furnaces Rotate

In the back center of Fig. 5 is the tall charging bucket containing 4 tons of scrap which is used to charge the furnace. This bucket is charged at the scrap bins shown in Fig. 6 and transported across on a car on the transverse track shown in the foreground of Fig. 6. A 6-ton 38-foot span crane manufactured by the Northern Engineering Works, Detroit, carries the loaded bucket from the car to the furnace. The electric furnace used is known as the multiple type and is manufactured by William Swindell & Bros., Pittsburgh.

Each unit consists of two furnace bodies, each with a tilting mechanism mounted on an electrically driven turntable as shown in Figs. 1, 2 and 7. The steel masts supporting the electrodes and their jibs are set on a foundation independent of the furnaces. Since only one set of electrodes are used, only one electrical substation is provided. When the heat is ready to be poured the electrodes are raised at a high speed stated to be about nine times the normal speed of travel during melting, the turntable is given a half rotation which brings the furnace with the molten charge to the pouring pit and brings the other furnace under the electrodes. The electrodes then are lowered into this furnace at high speed until the melting range is reached when the speed is slowed. L. M. Bassini, general manager of the Burnside company, stated that the elapsed time from raising the electrodes from one furnace, rotating the table, and lowering them into the other furnace is about 6 minutes.

After the furnace is poured the roof is removed by a special roof lifting crane designed by the Burnside company. This crane may be seen on the right in Figs. 2 and 7. Essentially, it consists of two I-beams which fit into two sets of lugs on opposite sides of the roof. The I-beams are raised and lowered by an electric hoist. The set of I-beams which engage the roof lugs, and the electric hoist are mounted on rollers which in turn rest on a set of fixed I-beams. A push or a pull on the movable section causes the roof to be moved toward or away from the furnace.

Charge Furnace

When the roof is moved away from the furnace, the bottom dump charging bucket shown in Fig. 5 with its charge of 4-tons of metal is raised over the furnace and the contents emptied. The top is then replaced to retain the heat and as shown in Fig. 2 an oil burner directed into the charging door serves to preheat the charge until the other furnace with its molten charge is ready for pouring.

Preheating with an oil burner makes little, if any, difference in the actual cost of melting, but an important advantage is gained thereby. This is the saving in time which in any metallurgical operation is important. According to data at hand about 7 gallons of oil at 5 cents a gallon are used to preheat a ton of metal. With a 4-ton charge this would be $1.40. However, as previously mentioned, the primary consideration of preheating is to save time, and from data gathered over a long period of time, the Burnside company estimates that from 20 to 25 minutes are saved in the melting time for each heat.

The furnace is of the acid type, lined with silica brick. Each car of purchased scrap is analyzed for silicon, sulphur, phosphorus and manganese. Sulphur and phosphorus are limited to a maximum of 0.045 per cent. The laboratory is situated close to the furnace and is well equipped for analytical determination. H. C. Be Ment, metallurgist, operates the electric furnace and between heats performs the necessary analyses. Each heat is analyzed for silicon, manganese and carbon, and the sulphur and phosphorus are determined once a week or more frequently if necessary. Carbons are estimated in the minimum time, about 11 minutes being the average time for a determination. Speed of operation is attained by having the elec-

(*Concluded on Page* 642)

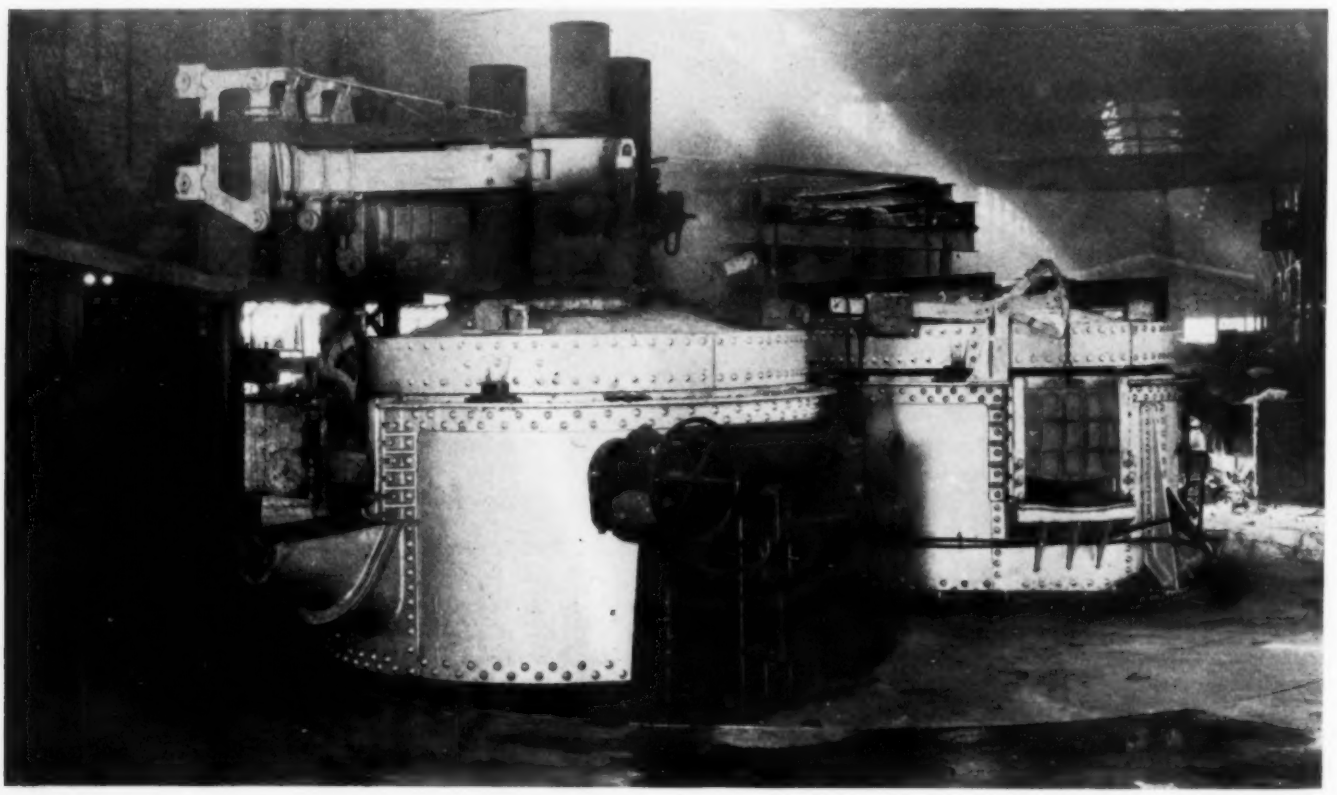


Fig. 7—Close-Up View of the Furnaces. The Tilting and Rotating Mechanisms May Be Noticed on the First Furnace. The Roof Lifting Device Is Above the Furnace on the Right

Heat Treating Definitions Approved by Technical Societies

DURING recent years certain confusion has arisen in regard to the meaning of commonly used heat treating terms. For instance, in one locality or trade, any operation of heating and cooling resulting in a softening of the material, is being called annealing, whereas in other places to "anneal" means not primarily "to soften" but to heat to above the critical temperature and cool very slowly. Similar confusion as to meaning and application exists in regard to other terms and as a result "annealing," "tempering," "normalizing," etc., are being used by different people, to mean widely different things.

In any attempt to accurately define the terms commonly used in connection with heat treatment, the first question to decide and the most important one is: Do the terms relate to the heat treatment operation itself, or to the results obtained by the treatment? In other words, is the term indicative of the structure or the condition obtained, or of the operation performed?

After careful consideration, it appears most logical and most in keeping with present-day usage to have the terms so defined that they shall mean definite operations and shall not be considered as referring to the resultant structures or general conditions.

By "critical temperature range," as used in these definitions, is meant that temperature range illustrated by the diagram in Fig. 1, taken from Howe.

1. HEAT TREATMENT—*An operation, or combination of operations involving the heating and cooling of a metal or an alloy in the solid state.* Note: This is for the purpose of obtaining certain desirable conditions or properties. Heating and cooling for the sole purpose of mechanical working are excluded from the meaning of this definition.

2. QUENCHING—*Immersing to cool.* Note: Immersion may be in liquids, gases or solids.

3. HARDENING—*Heating and quenching certain iron base alloys from a temperature either within or above the critical temperature range.*

4. ANNEALING—*Annealing is a heating and cooling operation of a material in the solid state.* Note (A) Annealing usually implies a relatively slow cooling. Note (B) Annealing is a comprehensive term. The purpose of such a heat treatment may be: Note (E) To remove gases; (a) To remove stresses; (b) To induce softness; (c) To alter ductility, toughness, electrical, magnetic or other physical properties; (d) To refine the crystalline structure. In annealing, the temperature of the operation and the rate of cooling depend upon the material being heat treated and the PURPOSE of the treatment. Certain specific heat treatments coming under the comprehensive term "annealing" are:

A. NORMALIZING — *Heating iron base alloys above the critical temperature range followed by cooling to below that range in still air at ordinary temperature.* Note: In the case of hypereutectoid steel, it is often desirable to heat above the ACcm line, as shown in Fig. 2.

B. SPHEROIDIZING—*Prolonged heating of iron base alloys at a temperature in the neighborhood of, but generally slightly below, the critical temperature range, usually followed by relatively slow cooling.* Note: (a) In the case of small objects of high carbon steels, the spheroidizing result is achieved more rapidly by prolonged heating to temperatures alternately within and slightly below the critical temperature range. (b) The object of this heat treatment is to produce a globular condition of the carbide.

C. TEMPERING (also termed Drawing)—*Reheating, after hardening to some temperature below the critical temperature range followed by any rate of cooling.* Note: (a) Although the terms "tempering" and "drawing" are practically synonymous as used in commercial practice, the term "tempering" is preferred. (b) Tempering meaning the operation of hardening followed by reheating is a usage which is illogical and confusing in the present state of the art of heat treating and should be discouraged.

D. MALLEABLIZING — *Malleablizing*

(*Concluded on page* 646)

Terms Are Adopted

MORE than two years ago, the American Society for Testing Materials, the Society of Automotive Engineers and the American Society for Steel Treating appointed a joint committee for the purpose of standardizing heat treating definitions and terms. This step was taken because of certain conflicts which were creating confusion. The joint committee after considerable effort proposed a set of standards and at early dates approval was secured from the American Society for Steel Treating and Society of Automotive Engineers. Approval of the American Society for Testing Materials was given at its recent meeting. The accompanying article reports the tentative standards as adopted by the three societies. The personnel of the joint committee is as follows: A. S. T. M., John Howe Hall, H. M. Boylston, G. B. Waterhouse; S. A. E., George L. Norris, Stanley P. Rockwell, John A. Mathews; A. S. S. T., J. Fletcher Harper, W. J. Merten, Bradley Stoughton and J. Edward Donnellan, secretary.

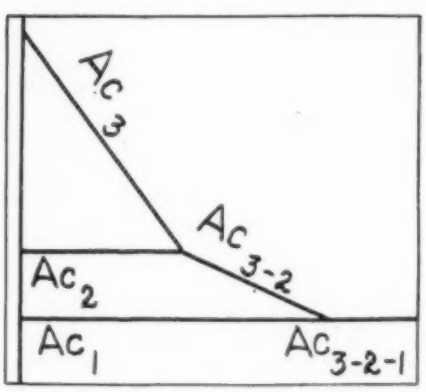


FIG. 1—DIAGRAM SHOWING CRTICAL TEMPERATURE RANGE

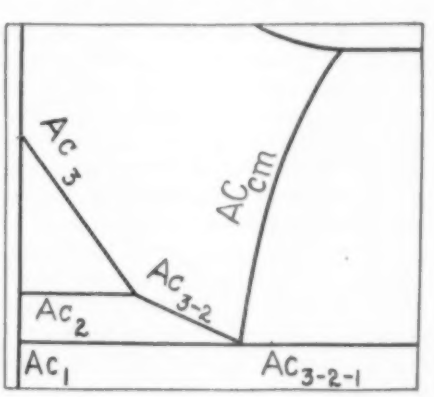


FIG. 2—DIAGRAM SHOWING THE NORMALIZING RANGE

Sodium Carbonate Compounds Affect *Refractory* Linings

By George S. Evans

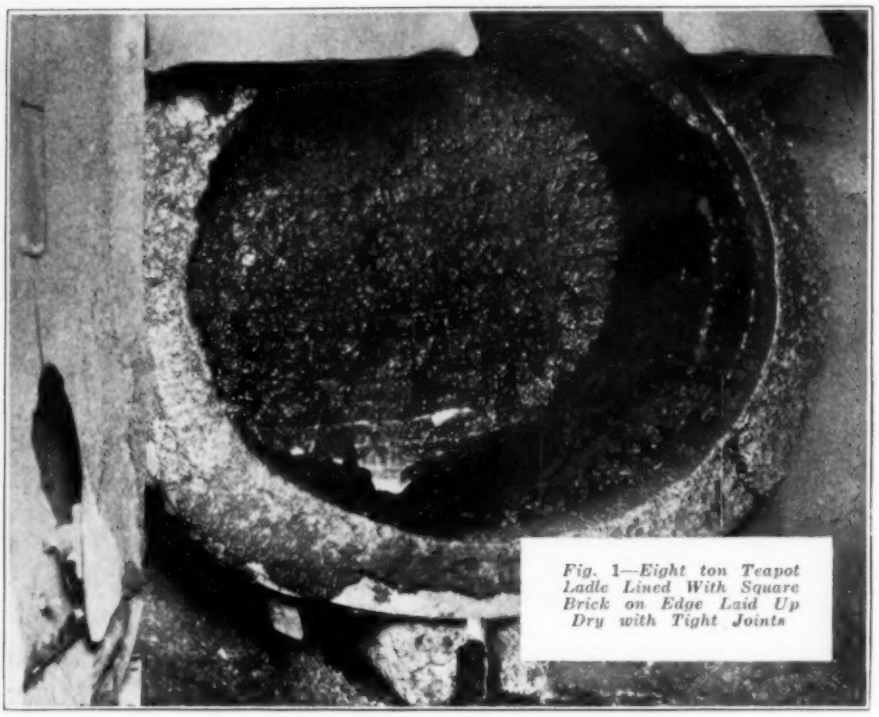


Fig. 1—Eight ton Teapot Ladle Lined With Square Brick on Edge Laid Up Dry with Tight Joints

SODIUM compounds have come into extensive use in the foundry industry during the past few years. Present uses include refining molten iron from the cupola in a teapot reservoir ladle or forehearth, desulphurizing in a crane ladle, as a final slag in air furnace malleable practice, for fluxing brass in oil and gas fired furnaces and as a cupola flux.

The purpose of this article is to set forth something of the nature and importance of the present development of the use of alkalies in foundry practice and to outline briefly the effect upon refractories of a special sodium compound manufactured by the Mathieson Alkali Works, Inc., New York, in its various uses, as developed in regular practice at different plants. It is hoped that this will be the means of developing a frank discussion of the subject and of creating an interest among fire brick manufacturers in the development of a lining material better suited to withstand the corrosive action of sodium alkali slags as refining baths on molten iron.

The sodium compound is fused soda ash especially prepared in two pound bricks to meet the requirements of the foundry industry. It is made by fusing the flowers of soda ash in a closed oven and casting the liquid compound into pigs. It will analyze 99 per cent sodium carbonate (Na_2CO_3). The fused brick will not absorb moisture and melts gradually when brought into contact with molten iron, which prevents any possibility of explosion or injury to operatives from flying alkali dust.

Sodium carbonate is a manufactured alkali strongly basic and exceptionally reactive chemically. It melts at 1560 degrees Fahr. and is decomposed at 2240 degrees Fahr. by molten cast iron, liberating free sodium. It also decomposes in the presence of incandescent coke. The value of soda ash as a refining agent for cast iron is due to its strongly basic properties, low fusion point and extreme activity at comparatively low temperatures.

Refines Cast Iron

The alkalies function at the temperature of cupola metal along the same general chemical reactions which take place with limestone at open-hearth or electric-furnace temperatures. This is symbolically illustrated as follows:

Limestone

$$CaCO_3+FeS=CaS+FeO+CO_2$$
$$CaO+SiO_2=CaO+SiO_2$$

Soda Ash

$$Na_2CO_3+FeS=Na_2+FeO+CO_2$$
$$Na_2O+SiO_2=Na_2O+SiO_2$$

It is practical to remove 10 to 40 per cent of the sulphur present in molten cast iron as it comes from the cupola by subjecting it to a bath of this sodium carbonate, in either a teapot ladle or forehearth, (illustrated in Figs. 3 and 4), without impairing its casting temperature or otherwise interfering with regular foundry operations.

The particular properties which make sodium carbonate a powerful refining agent for cast iron at cupola temperatures also account for the corrosive action of the sodium slag upon the ladle or forehearth lining. These properties include strong affinity for acids, including sulphur compounds, oxides, and silicious slag inclusions occuring in molten cast iron, as well as silica and silicates present in the lining. The extent of the corrosion will vary with the character of the lining, the quality and kind of alkali and the working conditions.

Sodium slag attacks free silica or silicates in mud grouting quite vigorously at the temperature of cupola metal, forming sodium silicates. This action is not so pronounced upon burned brick of similar composition where the different ingredients have been sintered together, so that it is important to reduce the use of mud to a minimum, first, for the reason that it is rapidly cut out by the slag, loosening the brick and allowing them to fall out and, second because of the action of mud in diluting or neutralizing the sodium. Generally speaking, the efficiency of the slag is inversely proportional to the percentage of silicates present.

Figs. 1 and 2 show the right and wrong methods of laying up the ladle lining. It will be noted that the face lining of the ladle Fig. 1 was made of arch brick laid up with tight joints

and that 9-inch straights laid flat in mud was used in the ladle shown in Fig. 2. Both ladles were lined with the same brand of fire brick and had been in service two weeks at the time of the photograph, handling 140 tons of iron per day using 6 pounds of sodium compound per ton. The conditions of the two linings illustrate clearly the importance of correct lining practice in minimizing the cutting action of the slag.

Observe Ladle Lining

Numerous experimental ladle linings laid up with different brands of fire brick and plastic lining materials have been under observation during the past 3 years without developing any outstanding results. The observation to date may be summarized as follows:

1. Linings laid up from high quality diaspore bricks generally used in glass industry for fusing soda glass mixtures gave less service than those from the ordinary run of fire brick.
2. Tests of several neutral materials including chrome and magnesite bricks indicated the impracticability of this type of lining.
3. Thus far, monolithic linings have not proven as economical as fire brick.
4. Little difference was noted in the life of linings laid up with clay brick of high or low silica content.
5. Dense and comparatively hard burned brick generally gave the longest service.
6. Trueness of form which permits of tight joints is of particular importance in determining the life of the lining.

Experiments are under way with ganister linings and vitrified brick which have a tendency to expand in service, thereby sealing the brick joints more tightly. However, present data is insufficient to justify any statement on the merits of either type of lining.

Recommended practice, which generally is followed by all foundries using the process, is to use a double thickness lining made from selected dense hard well burned brick true to form. Lay up the lining dry, or with a thin dip made of exceedingly fine material which permits of close joints. Any holes developing with the use of the lining are filled up daily with a good plastic fire brick material, otherwise no patching of importance is attempted. When the face brick start to loosen up badly, a whole new inside lining is installed.

With the proper ladle lining constructed as illustrated, the average life of linings, as determined by use in the chilled iron wheel industry during the past few years, will vary between 24 and 36—120 ton heats. This represents approximately one-half the life formerly obtained under similar operating conditions but before adopting the refining. The added cost of ladle linings with the refining, once the proper method of laying up brick is established, has been determined variously by different foundrymen as between ¾ and 1 3/4 cents per ton of iron refined.

Refining is carried out similarly, whether ladle or stationary forehearth is used and the same lining problems apply. However, with the latter, owing to its upright position, the difficulty from loosened bricks falling out during the heat is lessened, which permits longer use of the lining without danger of a run-out.

The action of the sodium compound in the cupola is illustrated and explained in Fig. 5. The effect of the compound on the cupola lining, with some exceptions, usually is beneficial. This results from improvements in melting operations brought about by the more active slag, together with

FIG. 2—INCORRECT METHOD OF LINING TEAPOT LADLE WITH BRICK LAID FLAT IN MUD GROUT

GEORGE S. Evans, author of this article which is abstracted from a paper presented at the spring meeting of the American Refractories institute held in Atlantic City, N. J., May 18, was graduated from the Virginia Polytechnic institute in 1909. After graduation he spent a year as blast furnace chemist. He then became connected with the Lenoir Car Works, Lenoir City, Tenn. and organized the chemical and metallurgical laboratories of that company. Later he was made superintendent of the company and devoted three years to improving foundry operations and installing a steel foundry department. In 1919 he joined the Griffin Wheel Co., Chicago, and became superintendent of cupolas and metallurgist for all its foundries. He became connected with the Mathieson Alkali Works, Inc., New York, in 1925.

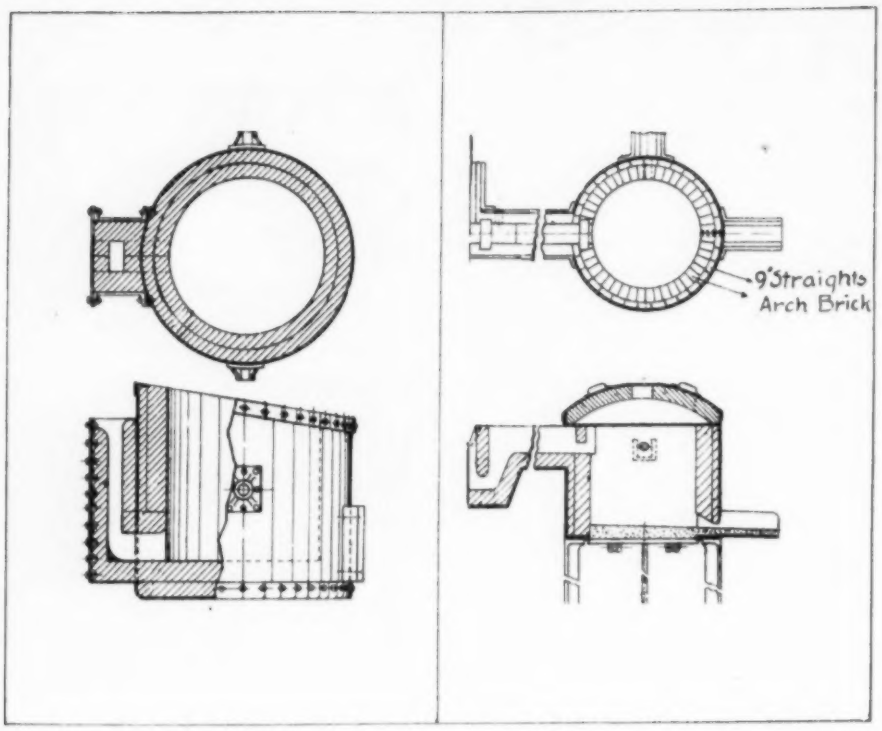


FIG. 3—TEAPOT RESERVOIR LADLE. FIG. 4—STATIONARY FOREHEARTH SHOWING DESIGNS OF EQUIPMENT AND CORRECT METHOD OF LINING FOR USE IN REFINING CUPOLA METAL WITH ALKALIES

a reduction in the volume of slag and less damage from chipping-out.

One of the newer uses of the alkalies in the foundry industry consists of refining air furnace malleable iron with a final slag of 5 to 15 pounds of fused soda ash per ton. Sulphur reductions of 10 to 25 per cent of that present in the bath are obtained regularly, together with some deoxidation of the metal and removal of slag inclusions, all of which combined tend to improve the annealing properties of the casting. Continued use of 10 to 12 pounds of the reagent per ton, extending over several months, has indicated that with the proper handling there is no injurious effect upon the furnace lining.

The action of alkalies in oil or gas fired brass furnace practice is, first, to increase the recovery of metal from the slag or dross, as it is called in this industry, and second, to prevent building up *niggers* or oxide-slag obstructions on the furnace lining.

The importance of the development of the sodium compound to industry is indicated by the extent of present usage. Over 95 per cent of all chilled iron railroad wheels produced in the United States and Canada are now refined with the sodium compound and it is used daily in over 300 cupolas. Practically all converter steel castings produced in the world are desulphurized with manufactured alkalies in some form. It is estimated that the manufactured alkalies will be used in connection with the production of over 3,759,000 tons of iron, steel and brass castings during this year and indications are that the practice will continue to increase.

The small added refractory costs, where such exist, resulting with the use of alkalies in the foundry industry, are scarcely comparable with the economies in practice and improvements in the quality of finished castings possible with their proper use. However, there is a present need for a special ladle brick which will better withstand the cutting action of molten cast iron and sodium slags.

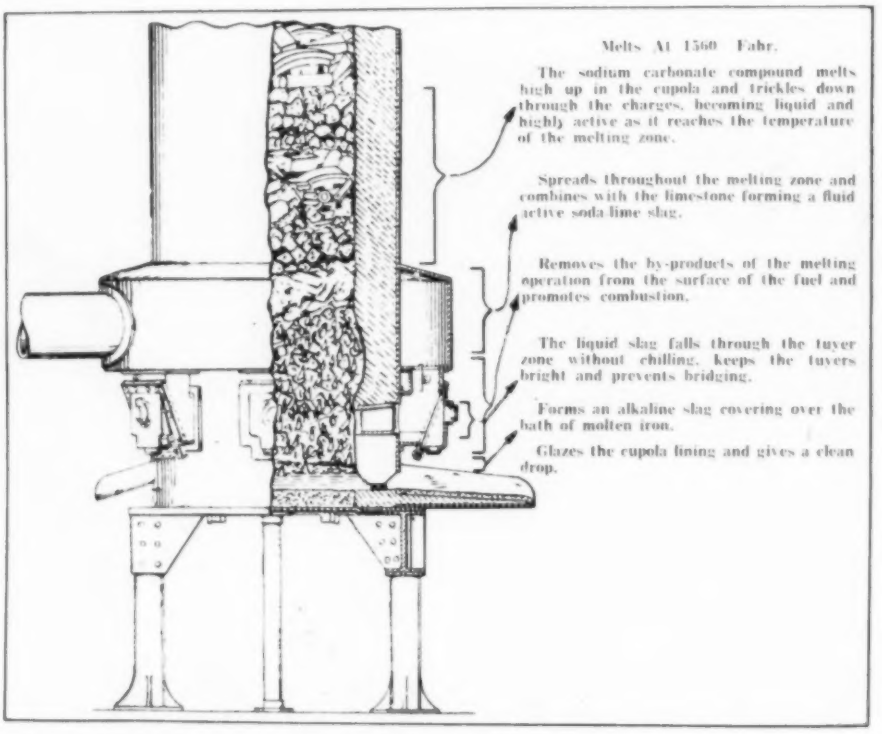

Melts At 1560 Fahr.
The sodium carbonate compound melts high up in the cupola and trickles down through the charges, becoming liquid and highly active as it reaches the temperature of the melting zone.
Spreads throughout the melting zone and combines with the limestone forming a fluid active soda lime slag.
Removes the by-products of the melting operation from the surface of the fuel and promotes combustion.
The liquid slag falls through the tuyer zone without chilling, keeps the tuyers bright and prevents bridging.
Forms an alkaline slag covering over the bath of molten iron.
Glazes the cupola lining and gives a clean drop.

FIG. 5—FOLLOWING THE VARIOUS SODIUM CARBONATE COMPOUNDS THROUGH THE CUPOLA

Electrochemists To Tour

Final reservations are being requested by the American Electrochemical society for its northwestern trip which leaves Chicago on Sept. 4 and returns there Sept. 21. Stops are to be made at Minneapolis; Butte, Mont.; Anaconda, Mont.; Wallace, Idaho; Kellogg, Idaho; Spokane; Seattle; Vancouver, B. C.; Trail, B. C.; Glacier Park; Shelby, Mont.; Great Falls, Mont.; and Keokuk, Iowa. Stops are to be made at these points and the visitors taken on inspection trips. Technical sessions are to be conducted at Minneapolis, Vancouver and Keokuk.

Will Do Galvanizing

Birmingham Galvanizing Co., Inc., has been organized at Birmingham, Ala. John F. Kent, formerly connected with the Tennessee Coal, Iron & Railroad Co. and the American Cast Iron Pipe Co., will be general manager, in charge of construction and operation of plant. Paul A. Ivy, former general sales manager of American Cast Iron Pipe Co., is chairman of the board, Harry Y. Carson is president, Thomas Blezard is vice president and sales manager and P. C. Jackson is secretary-treasurer. H. E. Cox, Carl James and C. M. Green are directors.

Stepping Up Production

Mechanically-III

By Pat Dwyer

SINCE conveyors of various kinds, gravity and power driven, have been installed in the cleaning, machining, assembling and shipping departments of the Austin Arcola plant of the American Radiator Co., Buffalo, the castings either singly or in assembled units, pass through in a steady stream instead of occupying valuable space and slowing down operations through congestion. This is the third and last of a series of articles dealing principally with the mechanical equipment of a plant where radiators and boilers are made. The first and second appearing in THE FOUNDRY *issues of July 15 and Aug. 1, dealt respectively with the molding department of the foundry.*

ALTHOUGH conveyors are employed extensively in every department of the Austin Arcola foundry of the American Radiator Co., Buffalo, they present particularly interesting features in that part of the plant devoted to the cleaning, testing, assembling and shipping the castings. Under former conditions, the castings were trucked from one point to another and from one machine to another in the regular sequence of operation. At each stopping place the castings were stacked in large numbers, partly because they were delivered intermittently in large quantities and partly because a stock had to be maintained in the vicinity of each machine and assembling station to insure constant operation of that particular unit. As a result the floor presented a severely congested condition with stacks of castings at various points and with a fleet of loaded trucks slowly trying to navigate the intricate and tortuous passages of the labyrinth.

Under the new arrangement, castings constantly are kept on the move. Consequently they do not pile up at any point to constitute an obstruction. They are confined to regular travel routes and as a result the various parts retain their identity. Thus a constant check may be kept on the number of individual parts at all times and any necessary adjustment made at the producing end of the cycle to meet fluctuating conditions. Each boiler is made up of a front, a back and several center sections and the conveying units are arranged in a manner that will deliver the sections to the assembling stations in the proportion of three center sections to each pair of front and back sections. Of course the same general scheme is in force all the way through, commencing at the molding machines

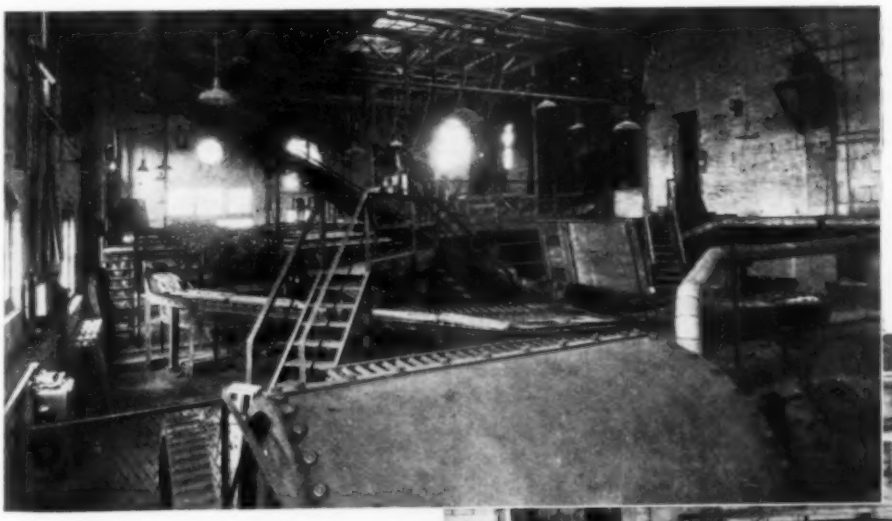
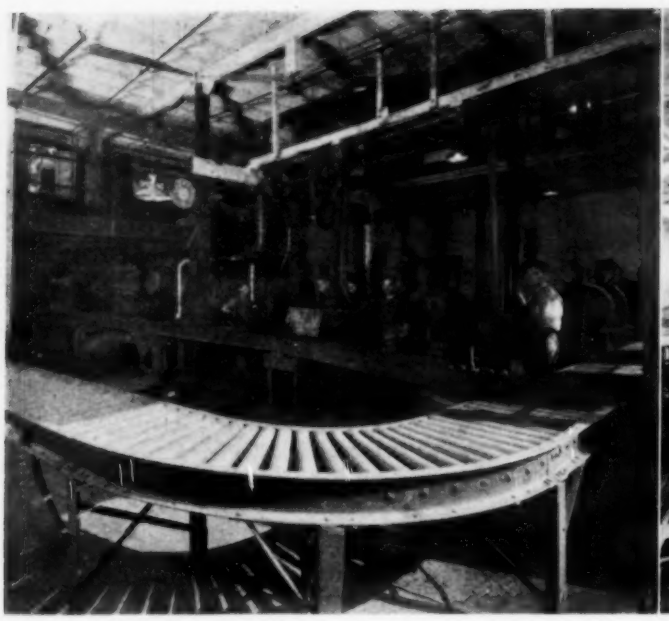


Fig. 2—This Five-way Switch Diverts the Castings According to Classification to Various Points on the Machine

Fig. 1—Castings Coming in on Conveyors to the Cleaning Room First Are Distributed to the Various Tumbling Barrels and then Taken on a Power Lift to a Switch



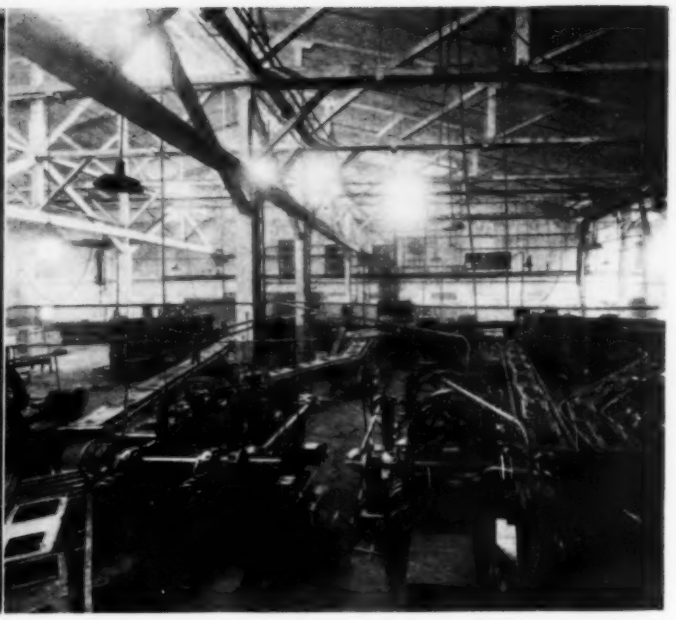


Fig. 3—Plate Work Coming Down a Spiral Conveyor Is Distributed to the Grinding Machines. Fig. 4—After Passing Through the Double Grinding Machines at the Back the Boiler Sections Are Reamed and Tapped on the Machines in the Foreground

where three, four or more center sections are made for each outside pair, depending on the style of boiler required to fill any current order.

A general view of the cleaning room is shown in Fig. 1 with the tumbling barrels close to the walls and the center of the space occupied by conveyors set at various angles and leading in many directions. Testing machines also are located in this room, the various boiler sections are subjected to a cold water pressure test of 120 pounds per square inch before they proceed any farther on their journey. Plate castings which include all the small miscellaneous parts, doors, covers, lids, grates, rests, knobs, handles, are taken from the tumbling barrels and loaded into pans, some of which may be noted on the conveyor to the right in Fig. 1. Only one species of casting is loaded in each pan to facilitate the work of the men assembling the boilers. Castings are loaded promiscuously into the tumbling barrels and this system of afterward loading them into comparatively small pans is the first step toward handling them as individual units.

Castings Are Separated

Various conveyors in the cleaning room converge to a point where all the castings are transferred to a power lift which may be noted in the center of the illustration Fig. 1. At the highest point of the power lift the castings are dstributed through a 5-way switch and carried on gravity roller conveyors for a distance of nearly 600 feet to various points in the grinding department. Plate castings loaded in the pans referred to previously are carried into the grinding department on a spiral conveyor shown to the extreme left in Fig. 2 and in the background to the left in Fig. 3.

The two conveyors, shown nearest to the spiral in Fig. 2, take the center boiler sections to the double grinding machines. Front sections are loaded on the next conveyor to the

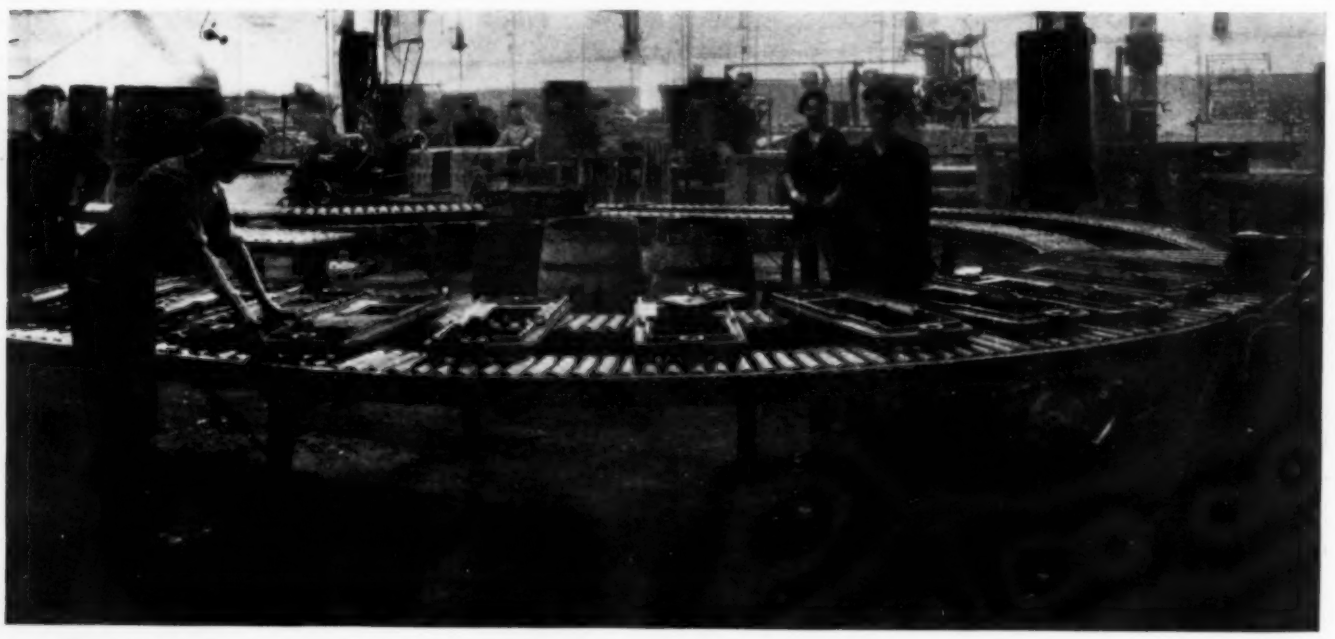


Fig. 5—Putty Is Applied to the Joint Face of the Sections on the Horseshoe Conveyor Before they Are Placed on a Machine and Pulled Up Tight With Right and Left Threaded Nipples

Fig. 6—Accessory Parts Known as Plate Work Is Attached to the Boilers While They Are Moving on a Power Driven Conveyor that Travels at the Rate of 3 Feet Per Minute

right and back sections are despatched to the grinding room on the fifth and last section of the conveyor in this group. In this connection it is interesting to note that gravity which cost nothing is employed almost exclusively in moving the castings from place to place in a steady sequence of operation that brings them eventually to the shipping station as completed heating units. In effect the present system equips each casting with a pair of roller skates which bear all the weight and expedite the rapid movement of the casting from its inception to its final discharge into a waiting freight car. The number of operators required has been reduced to a material extent and those who remain have been relieved of a great deal of the actual physical labor involved in handling these castings in the various stages of the journey.

A battery of double stand wheels for grinding the small castings is shown in the background of the illustration Fig. 3. These wheels are provided with dust catching hoods connected to a central exhaust system which keeps the air in this department free from dust made up of minute particles of metal and abrasive incident to grinding operation. Degree of accuracy required on the face of these castings may be inferred from the fact that the maximum variation allowed from absolute parallelism is only 0.006-inch. Pans of castings arriving at the bottom of the spiral conveyor emerge on the horizontal conveyor shown in the center of the illustration Fig. 3. This conveyor carries them past a number of short conveyors set at right angles to the main conveyor and leading toward the grinding wheel stands. The operator at each grinding station pulls the pan containing his particular castings from the main conveyor to the branch, grinds them, loads them in a second pan and pushes the pan to a point where a second branch of the main conveyor takes it first to the drilling and tapping machines, then to the assembly department. The first pan then is transferred to the far side of the wheels and in turn is loaded as in the preceding instance.

Boiler sections are ground, reamed and tapped in the room shown in Fig. 4 where the light from windows in the roof and sides of the building is

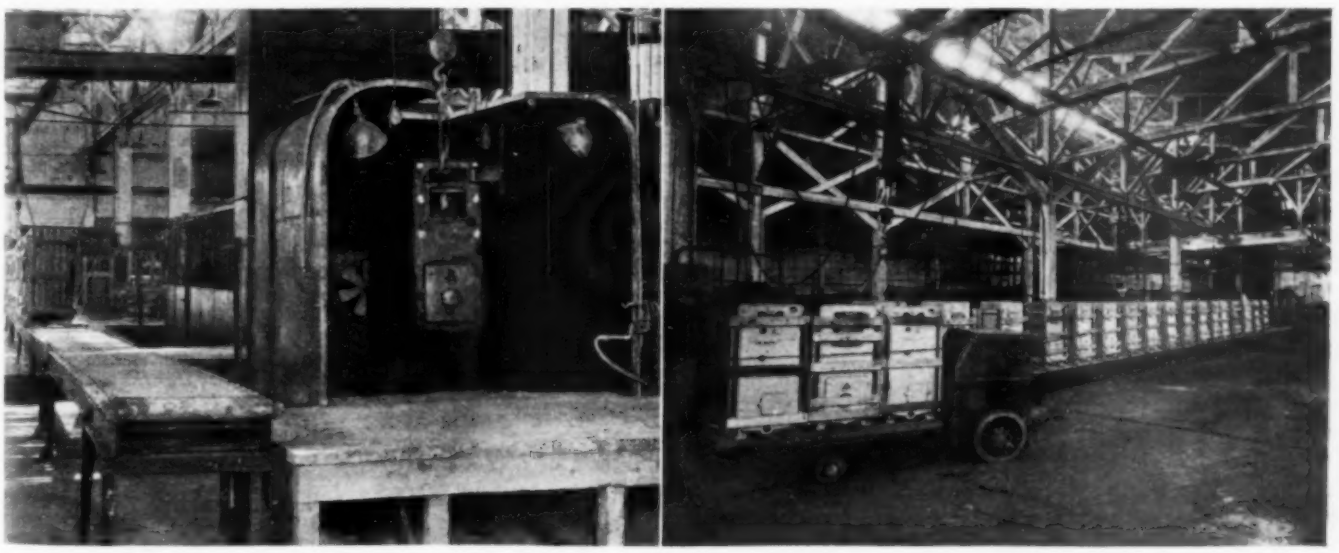


Fig. 7—Boilers Are Lifted from One Conveyor, Sprayed with Paint and Placed on a Second Conveyor Where They Are Crated. Fig. 8—Crated Boilers Are Placed on Skids and Taken by Truck Either to the Storage or to the Freight Cars

supplemented by a coat of whitewash on the inside. Castings are taken from the conveyor which extends across the end of the building, passed through the grinders and then placed on four conveyors which carry them past the reaming and tapping machines. In the illustration, Fig. 4, and reading from left to right in the usual manner the front and back sections are shown on the first and second conveyor. Center sections are shown on both the third and fourth. The grinding machines, individual motor driven and each provided with a pair of large parallel grinding wheels are shown at the back of the illustration. Castings pass between the grinding wheels on edge and are held to a limit of error in parallelism not to exceed 0.00250-inch.

Fig. 9—A Crane Type Truck Is Employed To Stack the Boilers in Tiers

Arrangement of the battery of machines for reaming and tapping the boiler sections is shown in the foreground of the same illustration. The front and back sections pass between one pair of machines while the center sections pass between a second pair shown to the right. The front and back sections only require to be reamed and tapped on one side. The center sections of course must be machined on both sides, since regardless of their relative position in the ultimate assembly, they will be located between two other sections. Single or double, two holes or four, front, back or center, all the necessary reaming and tapping on any given casting is done at a single operation. The casting is dropped into place and clamped. Two or four tools, as the case may be, are fed forward and then withdrawn. A second set of tools taps the holes either right or left hand depending on their position. The casting is removed, replaced on the conveyor and the following casting is treated in the same manner.

Center sections are routed directly from the reaming and tapping machines to the assembly department. Front and back sections are passed under multiple drilling machines where they are drilled and tapped for the reception of the various accessory parts. Each of these machines if necessary is capable of drilling or tapping 27 holes at one operation.

From the machined parts arriving at the horseshoe conveyor, shown in Fig. 5, the operators select a front, a back and a sufficient number of center sections to make up the proposed boiler and place them in their proper relative position on a machine which joins them firmly together with right and left threaded nipples. A putty *worm* is placed on the upper joint face of each casting as it lies on the conveyor preparatory to assembly. This is flattened out when the sections are drawn together and insures an absolutely tight joint.

After the sections are assembled, the entire unit is carried on a gravity roller conveyor to a second testing station where it is subjected for a period of 10 minutes to a cold water pressure of 80 pounds per square inch.

Up to this point the sections have traveled either flat or on edge. Leaving the testing station they are lifted to an upright position and placed upon their own feet, the same feet that ultimately will support them after they have been installed in their final destination in the basement of some customer's dwelling place. Also, they remain in this upright position throughout the remainder of their journey through the plant—and afterward.

A board 2 feet square and resembling an ordinary foundry bottom board, cleat side up, supports each boiler on the conveyor which carries it from the testing station to the power driven conveyor shown in Fig. 6. The point at which one conveyor touches the other may be noted slightly to the right of the center where the steps lead up to the platform.

The power conveyor 75 feet in length travels at the rate of 3 feet per minute and carries the boilers past three stations where the various small parts, referred to in the shop collectively as plate work, are stacked in readiness for the men who work on this assembly line. Opposite the first station the men attach the grate bars and manipulate them to see that they work freely. Men at the second station fit the clean-out and ash pit doors. At the third and final station the firedoor and firedoor pouch assembly it fitted into place. When the boiler arrives at the far end of this conveyor it is finished, complete, ready for installation with the single exception that it lacks a coat of paint.

This lack is made up in the booth shown in Fig. 7 where paint is sprayed on the surface while the boiler hangs suspended from a small power hoist. The booth is open in front and is provided with electric bulbs on the inside to furnish additional light and a fan at the back to draw the spray and contaminated air away from the operator.

Newly painted boilers are placed on the conveyor shown to the left in Figs. 7 and 8. In Fig. 7 the view is directed away from the paint booth while in Fig. 8 the view is directed in the opposite direction with the paint booth showing at the far end of the conveyor.

Boilers are crated while on this conveyor and then are lifted by an air hoist and loaded on a truck which either conveys them into a temporary storage as shown in Fig. 9 or directly into the freight cars. The type of truck shown in Fig. 8 is used for single tier loading while the crane type shown in Fig. 9 is employed where it is necessary to stack one tier on top of another.

Explains Brass Metallurgy-II

Phosphorus and Silicon in Small Quantities Used for Deoxidizers—During Melting the Metal Must Be Protected from the Gases of Combustion—Reverberatory Furnace Is Described

By Edmund R. Thews

IT HAS been found in general practice that most of the bronze alloys are considerably less porous if they contain 5 or 10 per cent zinc. This is due entirely to the high vapor tension of the zinc, the zinc vapors which are generated protect the surface of the bath and, particularly, the stream of metal against the formation of harmful oxides. The same property is shared by all other deoxidizing elements possessing a relatively low boiling point, particularly—in the case of most copper alloys—by phosphorus. The boiling points of ordinary metals are shown in the following table:

Element	Boiling point degrees Fahr.
Phosphorus	550
Arsenic	842
Potassium	1390
Cadmium	1436
Sodium	1607
Zinc	1688
Bismuth	2640
Antimony	2642
Nickel	2650
Silicon	2695
Lead	2910
Aluminum	3630
Magnesium	3990
Tin	4120
Copper	4170
Manganese	4530

Thus, the only elements which will be vaporized appreciably at the temperature of the brass melting processes are phosphorus, arsenic, potassium, cadmium, sodium, and zinc. Of these, cadmium is not suitable for deoxidation purposes in brass melting, since the high specific weight of its oxides, 8.2, as against the average specific weight of brass alloys, 8.0, tends to contaminate the metal with oxide.

The specific weights of the oxides of true deoxidizing agents are much lower, as follows:

Compound	Specific weight
Potassium peroxide	abt. 1.0
Sodium peroxide	abt. 1.0
Phosphorus pentoxide	abt. 2.4
Arsenic trioxide	abt. 3.7
Zinc oxide	abt. 5.4

Gives Combining Power

If the different deoxidizing elements are grouped according to their respective affinity to oxygen, the following table is obtained in which the affinity of the elements is indicated by its heat of combustion in calories, per 1 gram-atom of oxygen:

This is the second of three articles on brass metallurgy. The third and concluding article will appear in an early issue.

Element	Calories
Magnesium	144
Aluminum	128
Silicon	94
Manganese	91
Zinc	85
Phosphorus	80
Tin	68
Iron	66
Cadmium	66
Nickel	59
Antimony	55
Arsenic	52
Lead	50
Copper	43

Of much greater practical importance, however, is the consideration of the quantitative efficiency of the deoxidizing elements, that is to say, the amount of oxygen taken up by equal amounts of the above elements. This is shown in the following table:

100 Grains of Element	Combines with Gr. Oxygen
Silicon	113.0
Aluminum	88.6
Phosphorus	77.3
Magnesium	65.8
Antimony	39.8
Arsenic	32.0
Manganese	29.1
Iron	28.7
Nickel	27.3
Copper	25.2
Zinc	24.5
Cadmium	14.2
Tin	13.5
Lead	7.7

Of the reducing agents ordinarily used for the deoxidation of brasses, silicon, phosphorus, and arsenic are the most important. Of these, the alloys of phosphorus are doubtlessly the most valuable.

The principle of the deoxidizing action of phosphorus is well known. The oxygen of the metallic oxides present in the melt combines with phosphorus to form PO_5 which is insoluble in the melt and rises to the surface where it volatilizes, forming yellowish white clouds. Phosphorus may be added in the form of phosphor-copper or phosphor-brass, containing 10 per cent of phosphorus. Of this alloy, 0.10 per cent will suffice to reduce all the oxygen usually found present in any of the common brasses under ordinary melting conditions. This is only 1/10 to 1/20 the amount of phosphorus alloy necessary for the deoxidation of straight tin bronzes, due to the protective influence of zinc. The exact amounts of phosphorus to be added depend upon the individual circumstances but should not exceed 0.02 per cent phosphorus or 0.2 per cent phosphor-copper. The addition of an appreciable excess of phosphorus should be guarded against, since this will be dissolved by the melt and deteriorate the properties of the castings, particularly the electrical conductivity.

Added in Ladle

The deoxidizing alloy is added to the metal in the ladle, while if crucible furnaces are being used, and the metal is poured out of the crucible, the deoxidizing agent should be added to the metal just previous to pouring.

Addition of the phosphorus alloy to the metal always is accompanied by a rise in temperature and a corresponding decrease of viscosity. Thus, a twofold effect is exerted by the phosphorus. Apart from the elimination of the oxygen content of the brass alloys, it increases the fluidity of the metal and facilitates the ascension of impurities mechanically suspended within the metal to the surface.

A considerable advantage of phosphorus as compared with other deoxidizing agents is due to the fact that phosphorus, like zinc, protects the alloys against the oxidizing influence of air while pouring. The thin stream of metal pouring from the lip of the ladle is particularly subject to oxidation, but the reducing phosphorus vapors emerging from the surface of the metal absorb all the atmospheric oxygen immediately surrounding the metal stream, keeping it encased, so to speak, within a layer of neutral atmosphere.

In the case of the normal copper zinc alloys, this protective action of the phosphorus vapors is of no practical importance if compared with that of zinc, but its importance increases

with decreasing percentages of zinc, particularly, if tin also is present in relatively large amounts. Apart from phosphor-copper and phosphor-brass alloys, other phosphorus alloys rarely are used for the reduction of copper-zinc alloys.

In European foundries, phosphorus is sometimes added to the ladle in its elementary state. The main disadvantage of this method is the low temperature of ignition of this element and the disagreeable and poisonous vapors generated if deoxidation is not carried through correctly. As a rule the addition of elementary phosphorus to the bath is effected by placing the substance into the hollow end of a graphite rod and plunging it down to the bottom of the ladle. To decrease the inflammability of the phosphorus it has been suggested to prepare the phosphorus by soaking it in a dilute copper sulphate solution for about 30 minutes. By this treatment a thin skin of metallic copper is formed upon the surface of the phosphorus, thus protecting it against ignition until fully submerged. The desired result is not always obtained. Efficiency of the phosphorus is lowered by oxidation.

Use Silicon as Deoxidizer

Silicon-copper alloys may also be used for the deoxidation of brass alloys. As in the case of phosphorus, good judgment must be observed in determining the amounts of this reducing agent to be added. Like the former, any excess of silicon will combine with copper, influencing the mechanical and physical properties of the brasses. Addition of this deoxidizing agent should be regulated so as to leave no silicon in the brass after the removal of the oxides. The oxidized silicon rises to the surface of the metal as a scum which may be removed easily. The addition of 0.1 to 0.2 per cent silicon-copper alloy containing 10 per cent of silicon will produce good and dense castings.

There is one exceedingly important difference in the action of the two deoxidation agents compared. A difference which is but rarely recognized in literature, and which is due to the respective vapor tensions of the two elements. In contrast to the combined reducing and preventive action of phosphorus, that of silicon is merely reducing. Although in this respect it is considerably more effective than phosphorus, the affinity of which for oxygen is not nearly as high as that of metallic silicon. The respective positions of these elements are given in the table of heat combustions and show that while the affinity of zinc for oxygen is somewhat higher than that of phosphorus, it is considerably exceeded by that of silicon. Conditions regarding the quantitative efficiency of these elements (combining power) are similar in a way, silicon leading the list of deoxidation elements with phosphorus in the third place behind aluminum.

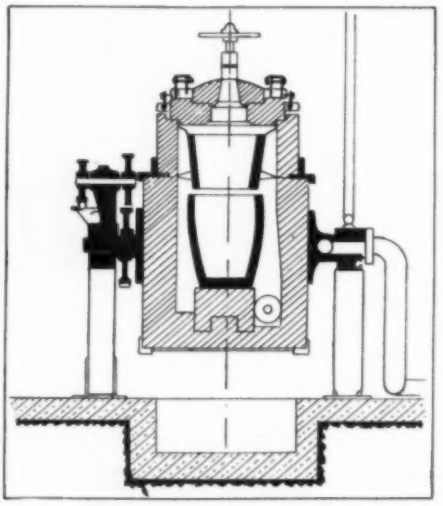


FIG. 1—OIL-FIRED CRUCIBLE FURNACE WITH DOUBLE LID

Forms Lead Compounds

If lead is present in the alloys, silicon should not be used as deoxidation agent, since at the high temperatures of reaction, silicon tends to form compounds with lead. Deoxidation will be insufficient and the lead silicate formed will cause considerable foaming of the metal, tending to produce unsound castings.

The well known method of removing small amounts of silicon from most copper alloys by treatment with a mixture of red oxide of copper and anhydrous sodium chloride (15 per cent NaCl) is not applicable in the case of zinc oxide. It spite of the higher affinity of silicon for oxygen the excessive amount of zinc present will prevent any oxidizing action of copper on silicon.

The action of arsenic as deoxidizing agent is similar to that of phosphorus, although qualitatively and quantitatively its reducing power is not nearly as high as that of the latter. For this reason, and because of its deteriorative influence on the mechanical properties of brasses, if added in excess, phosphor-copper generally is preferred to arsenic-copper.

The deoxidizing properties of manganese which has been recommended repeatedly as an exceptionally satisfactory addition to brass alloys also should be considered in this connection. Careful experiments have shown that the effects of manganese in brasses are all but deoxidizing. Instead of causing a certain increase of heat and fluidity of the bath, the addition of manganese-copper causes a considerable drop of fluidity. If the respective physical properties of manganese are compared with those of zinc, little doubt remains as to the unsuitability of manganese-copper alloys for deoxidizing brass alloys.

Temperature is Low

It appears that the relative high affinity of manganese, as indicated by its specific heat of combustion, does not become sufficiently effective at the comparatively low temperature of the brass melting process. This does not refer to the well known influence of manganese additions on the mechanical properties of brass alloys.

Much better results are attained by manganese-phosphor-copper alloys.

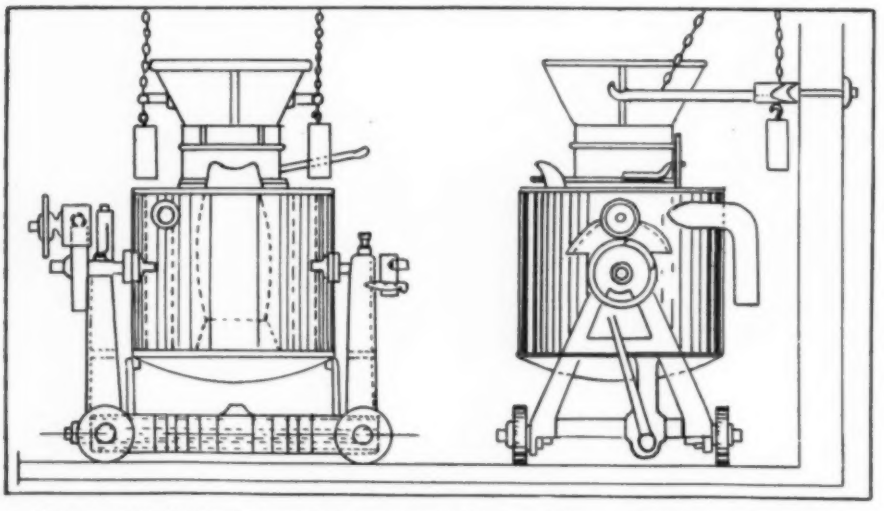


FIG. 2—PORTABLE TILTING-TYPE CRUCIBLE FURNACE SHOWING CHARGING FUNNEL AND METHOD OF APPLICATION

However, there can be no doubt, that in this group of alloys the deoxidizing element proper is the phosphorus, the influence of manganese exerting itself more along mechanical lines.

Magnesium-copper alloys, which also have been recommended for deoxidizing copper alloys, should never be used in brasses, the deteriorating influence of magnesium on copper in zinc alloys disqualifying them for this purpose.

Types of Melting Furnaces

Discussion of the deoxidizing elements shows that of all the fluxes suitable for the treatment of brass alloys, phosphorus in the form of phosphor-copper, phosphor-brass, or manganese-phosphor-copper seems to be the most valuable.

Four chief types of melting furnaces used for the production of brass alloys are the reverberatory furnace, crucible furnace, tilting oil furnace, and the electric furnace. All types give comparatively good results if used correctly and in the right place. Where large sized pieces of scrap, such as propellers, frames etc. are to be remelted, a fairly large reverberatory furnace will give excellent results. A simple calculation will show that the higher loss of zinc, most of which may be regained, is made amply up by the saving of labor and material required for cutting up large pieces of scrap. Wherever the charges melted do not contain excessively large pieces, the crucible furnace, or for larger smelting charges, the tilting oil furnace is used if the price of electric current plays a considerable part in the calculation of the smelter. Good results technically and—in the case of cheap current—economically are obtained with electric furnaces.

Modern tilting crucible furnaces fired by coke, gas, or oil, are economical regarding the wear of crucibles as well as the consumption of heat energy, as the crucibles need not be lifted out of the furnaces at each pouring. Since these crucibles do not require handling of any sort, much larger crucibles may be used, maximum capacities ranging up to 1000 to 1100 pounds of brass per charge. Fig. 1 shows a modern oil-fired crucible furnace with double lid and charging funnel (preheater), and Fig. 2 shows the arrangement of a movable tilting crucible furnace which in the case of a large working radius is fired with coke. The chief advantages of these movable types of crucible furnaces are:

Pouring directly from the furnace into the molds even at larger distances from the position of the furnace without decreasing the temperature of the metal.

Considerable reduction metal losses by oxidation during pouring.

Elimination of foundations and comparatively small cost of construction.

Quick and simple change of position of the furnace while melting down the charges.

Has Advantages

The advantages of the charging funnel shown in Fig. 1 are self evident. The hot gases in passing through the metal in the funnel and preheating it to high temperatures cause a considerable saving of heat and a corresponding increase of melting speed. The use and treatment of crucibles has been described in an article in THE FOUNDRY, April 1, 1926, and need not be discussed again.

To increase the capacity of the crucible plant, large, flat bottomed recuperating furnaces fired with gas, oil, or coke, and containing from six to twelve crucibles are frequently used. Since the furnace cannot be made tilting, each crucible must be removed from the furnace when the charge is ready to be poured, thus incurring the disadvantages inherent to all fixed types of crucible furnaces. Another serious disadvantage is that the metal is subjected to the deteriorating influence of the firing gases throughout the entire melting process, while the loss of zinc by oxidation is often excessively high because frequently several crucibles are ready to be poured at the same time, although but one or, at the most, two crucibles may be handled at one time. As a result, all the metal remaining in the furnace longer than absolutely necessary will be oxidized to an appreciably higher degree.

The oldest melting device for the production of copper alloys, the reverberatory furnace, is still being used to a large extent wherever large quantities of brass alloys must be melted as rapidly as possible and where electric current is not available, or too expensive for large consumption.

The only important, although serious, disadvantage of this type of furnace for the production or remelting of brass alloys in the comparatively large loss of metallic values by oxidation. This disadvantage may be neutralized to a large extent by proper construction of furnace and by expert operation of the melting process. The same is true of the other disadvantage, the absorption of sulphur dioxide and other gases by the melt.

It is clear that, since both disadvantages of reverberatory melting of brasses are due exclusively to the contact of the firing gases with the comparatively large surface of the metal, correct construction of these furnaces must provide for a reduction of the ratio, volume to surface of metal. The hearth must be made as deep as possible and the contact of the gases of combustion with the sur-

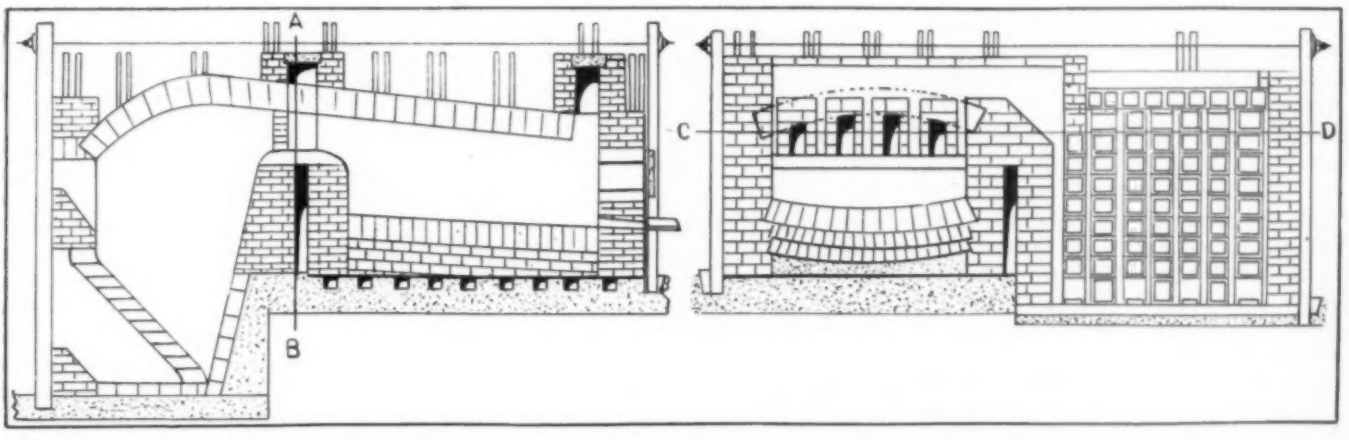


FIG. 3—REVERBERATORY FURNACE WITH SEMIGAS PRODUCER AND RECUPERATOR

face of the metal be reduced to a minimum by keeping the metal covered with an effective layer of flux.

Loss of zinc and other metals by oxidation may be decreased largely by maintaining a strongly reducing atmosphere in the furnace, by covering the bath with a rather heavy layer of charcoal or charcoal-coke breeze mixture, or by adding part of the zinc to the metal in the ladle, a custom which has given good results wherever the entire pouring process is left in the care of an expert operator.

The sulphurizing action of the firing gases may be reduced at will by burning fuels low in sulphur.

Fig. 3 shows a reverberatory furnace for the melting of bronze or brass alloys equipped with a semigas producer and recuperator constructed by the author for a large South German smelter which has given excellent results. The principle of the recuperator is simple and efficient. The hot gases of combustion pass from the furnace into a chamber at one end of the recuperator through three rows of hollow bricks into a second chamber at the other end of the recuperator. From here they are drawn through a second three rows of hollow bricks into the last chamber, lying side by side with the first chamber, from where the gases pass into the flue channels. The cold air is drawn into the recuperator, passes through the labyrinth channel into the collecting channel and, finally, through the distribution channels. On leaving these channels the preheated air mixes with the hot gases of combustion, partly unburned, completing the combustion process and concentrating all the available heat on the bath. This also tends to promote rapid melting.

The main advantages of the reverberatory furnace are: Possibility of producing large quantities of alloy of the same composition and, if poured correctly, the same chemical and physical properties.

Charging large pieces of scrap without previous cutting, particularly, if part of the roof of the furnace is made removable.

It is much more advantageous for several reasons to construct the removable roof in several sections which may be removed independently. It is exceedingly difficult to handle large pieces of scrap sufficiently careful to leave the hearth and walls of the furnace unhurt if the entire roof is taken off. The heat of the furnace radiates out at full volume and this loss of heat also must be considered. If unwieldy pieces are not charged with all due care, the heat of the furnace stored up in hearth and walls is decreased by many hundred degrees and the loss of fuel and time accrued is considerable.

Preheating Reduces Melting Period

(*Concluded from Page* 630)

tric carbon combustion furnace heated to a temperature of 1975 degrees Fahr. during the carbon estimation. At this high temperature the heating elements only last about 6 weeks, but the increase of speed in operation makes it worth while to replace the elements at these intervals.

A longer period is required to melt the first few heats in the electric furnace than for those that follow. Starting with a cold furnace the average time required in the furnaces used at the Burnside Steel Foundry is as follows: For the first two heats, 1 hour and 50 minutes to 2 hours; for the next two, 1 hour and 35 minutes to 1 hour and 40 minutes; the fifth heat, 1 hour and 10 minutes to 1 hour and 20 minutes. As many as 8 heats a day have been run in these furnaces, and the time was cut down to 55 to 65 minutes on the last few. This shows that the longer the furnace is in operation the quicker the heats melt.

Most of the castings manufactured by the firm are in the class known as light work. Some large castings are made, but the greater portion of the castings are used in automobile, tractor and railroad construction. The average weight of the castings made is 13 pounds and is claimed to be the lightest average weight sought by steel foundries in the Chicago-Milwaukee district.

Metal as cast has the following analysis: Silicon, 0.35 to 0.45 per cent; carbon, 0.21 to 0.27 per cent; manganese, 0.65 to 0.80 per cent. Since the steel scrap purchased is bought to a specification which limits the sulphur and phosphorus at a maximum of 0.045 per cent, these elements will not exceed 0.05 per cent in the finished product.

From time to time temperatures of the molten bath are taken. To obtain uniform conditions and eliminate slag coating the metal, a spoon is dipped into the furnace bath and the molten metal is poured into a fracture mold. The temperature is determined by an optical pyrometer manufactured by the Leeds & Northrup Co., Philadelphia. The average pouring temperature from the furnace into the 4-ton bull ladle is from 3250 to 3300 degrees Fahr. From data obtained over a period of 18 months, the average electric power consumption is from 550 to 565 kilowatts per ton of steel melted. Electrode consumption is from 10 to 11 pounds per ton of steel melted.

To Hold Meeting on Fuels

The first national fuels meeting arranged for engineers interested in the use and conservation of fuels will be held in St. Louis from Oct. 10 to 13 under the fuels division of the American Society for Mechanical Engineers. About 26 papers will be presented during the sessions which will be divided into general, industrial, power plant and smoke abatement discussions. Authors of papers will include Prof. S. W. Parr, University of Illinois, Urbana, Ill.; Prof. R. T. Haslam, Massachusetts Institute of Technology, Cambridge, Mass.; Prof. W. Trinks, Carnegie Institute of Technology, Pittsburgh; A. C. Fieldner, United States bureau of mines; Stewart Phelps, Mellon Institute, Pittsburgh; W. B. Chapman, Chapman Engineering Co., New York; H. M. Cushing, Buffalo General Electric Co., Buffalo; Prof. A. S. Langsdorf, Washington university, St. Louis, and other noted men in the field.

To Make European Tour

The American Ceramic society has arranged a tentative itinerary for its proposed 1928 European tour which will include visits to important ceramic centers of various countries. The tour will include visits to Stoke-on-Trent and the Potteries in England; Glasgow, Scotland; Delft, Holland; Meissen, Germany; Prague, Czechoslovakia; and Paris. The tour will cover about 6000 miles and will extend 6 weeks from May 19 to July 5, 1928.

Stops Pores in Castings

Question—Is there any way to stop the pores in castings which leak?

Answer—Two methods are available for closing up the pores in castings. One is to soak the casting for an hour or so in a solution of ammonium chloride, then pull it out and let it stand until the holes are closed by rusting. Another method is to force a dilute solution of sodium silicate (water glass) through the pores of the metal. The sodium silicate is then removed from the inside of the casting and the casting washed.

How and Why in Brass Founding

By Charles Vickers

Melt Bronze in Cupola

We have to make a number of large bronze castings 22 inches in diameter; 36 inches long, with a 6-inch cored hole through the center and weighing from 3500 to 4000 pounds each. We have made castings weighing up to 5600 pounds but in this instance the metal thickness was only 1½ inches. These were cast from cupola melted bronze and we wonder whether we could expect to get the thicker castings we have mentioned from the cupola, provided we cleaned it out well, first pigged the bronze, then melted it in the cupola, Would this affect the mixture of the metal?

If the mixture happened to be a yellow brass, quite naturally a considerable loss of zinc could be looked for, and this would alter the composition somewhat, but in the case of an alloy like 88-10-2, there would be little change. If the specification had to be held pretty close, it would be advisable to charge 3 pounds of zinc instead of 2 pounds per hundred, and 3 ounces additional tin, thus making 101 pounds, 3 ounces of metal instead of exactly 100 pounds, when making the ingots. After passing through the cupola the mixture would then be close enough to what was wanted. Some bronze melters in cupola melting prefer to use a softer blast than for iron. The main thing as we see it is to get the bronze out of the cupola and into the molds with as little delay as possiblle. Therefore, everything should be in readiness for the handling and reception of the molten metal as soon as it is molten.

The charming thing about a cupola from the melters point of view is the fact of its bringing the metal down so quickly, thereby allowing a limited time for oxidation, sulphurization and gasification. In view of the fact that the latter difficulty is brought about by reducing conditions in a furnace, not by oxidizing ones, there does not appear to be much chance of its happening in a cupola. Therefore, it may be possible that a cupola is adapted to handling large heats of bronze better than it has been given credit for. Numbers of foundrymen have obtained most excellent results using this melting furnace.

As far as the thickness of the casting is concerned, if feeders can be used that will solidify after the metal in the mold, the casting cannot help but be sound. If this is not possible, there will be difficulty. If the casting is a straight cylinder and is cast on end, a sullage head of suitable length will take care of the shrinkage nicely as this is the way in which bronze cannon were cast. If considerable metal is turned off and the casting must withstand heavy pressure, add 2 per cent of nickel to the mixture. Castings of this size could be best made in permanent molds, but for one casting the cost would be prohibitive.

Should Change Mixtures

We are melting brass of the following composition: Copper, 65 per cent; zinc, 34 per cent; tin, 1 per cent. This metal is to be polished for use on yachts. When it is polished, many small holes are revealed which show up black. We are using glass in melting but that does not overcome the difficulty. Can you suggest a remedy?

The holes appear black after polishing because they are filled with the polishing compound or other dirt. The addition of 0.25 per cent of manganese copper might give relief and is worth a trial. The composition, however, is not suitable for a casting yellow brass, especially for the service mentioned. Therefore, it would be advisable to change the alloy, and we suggest the following: Brass, 75 per cent; copper, 22 per cent; tin, 1 per cent; lead, 2 per cent. Melt the copper and brass together, if the brass is borings, charge it onto the copper, the latter being at the bottom.

This will give an alloy of approximately the following composition: Copper, 70.75 per cent; zinc, 25.50 per cent; tin, 1.75 per cent; lead, 2 per cent, which is a nice casting alloy needing no aluminum. Vent the molds with scratch vents from corners of casting matrixes to side of flasks to vent off the zinc oxide, also cut ditches on back of copes to prevent the weights from sealing the tops of molds against the outlet of the gases when the molds are poured. If the holes persist after that change, something is radically wrong, either with the manner of melting or with the molding sand, but we are unable to determine what that might be from the evidence in our possession.

Castings Are Porous

We are using miscellaneous scrap brass for making jobbing castings but have trouble from porosity. Can you advise what causes this? We have no brass sand, and what we are using sticks to the castings so we can hardly chip it off, and it is full of bits of brass. We have no way of taking the temperature of the metal, but get it good and hot. We are using a little flour in the sand for facing, but it does not make the castings peel. What is a good facing?

The so-called brass sand is a grade suitable for small fine castings. For an ordinary jobbing shop it is better to use a grade approximating a No. 2 Albany. To learn just how coarse or fine this grade is, it is advisable to purchase a few barrels from advertisers in THE FOUNDRY. This eliminates all guess work. We are unable to advise regarding the cause of porosity with any degree of confidence as there may be any number of causes, and the cause will have to be discovered by elimination.

Molding sand may be blamed and to be certain it does not come from this cause, or otherwise, use the Albany sand aforementioned for a couple of weeks. We suggest you dust flour on the finished molds, but do not mix any in the sand. For medium weight castings it will not be necessary to use facings, but when it is, a simple facing may be made by mixing half new with half old molding sand and then adding and thoroughly mixing therewith, one part flour to 20 parts mixed sand. Should the porosity not be entirely banished by the sand change, something may be wrong with the melting practice. If melting is done in a coke-fired crucible furnace, see that considerable charcoal is used with each heat, so a covering of this material floats on the surface of the metal, add two ounces phosphor copper.

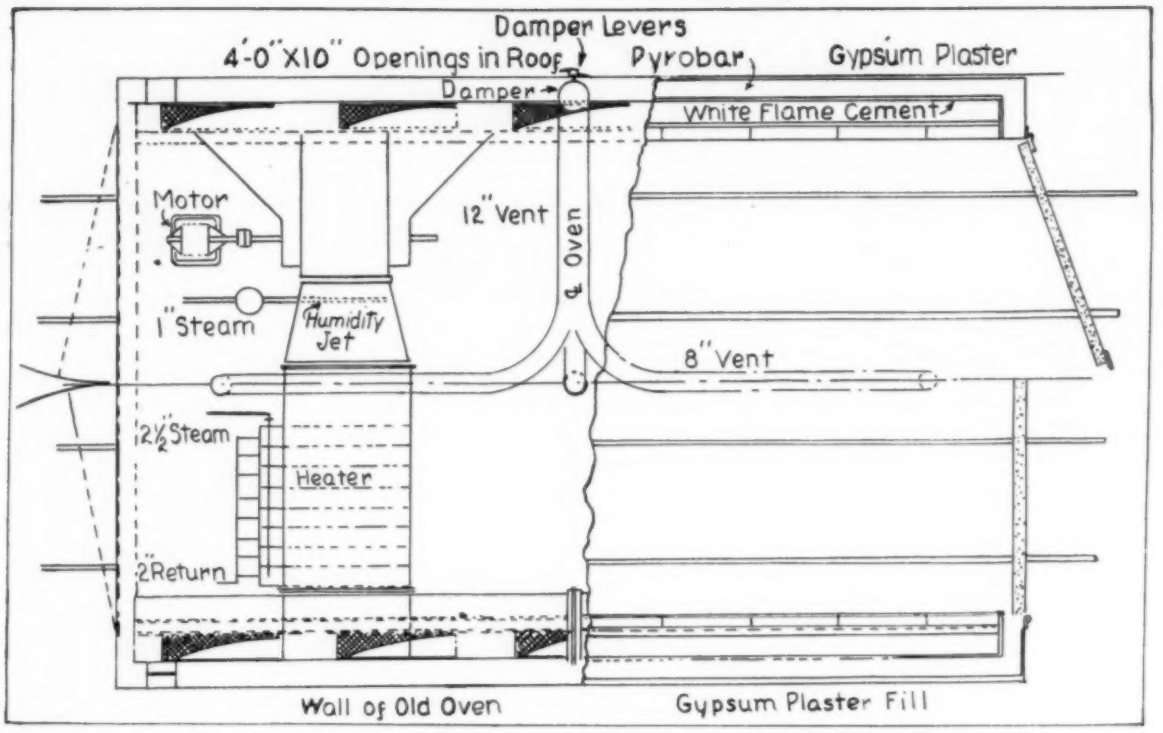


Fig. 1—Plan View of Core Oven Into Which Steam Is Introduced

Humid Oven Atmosphere

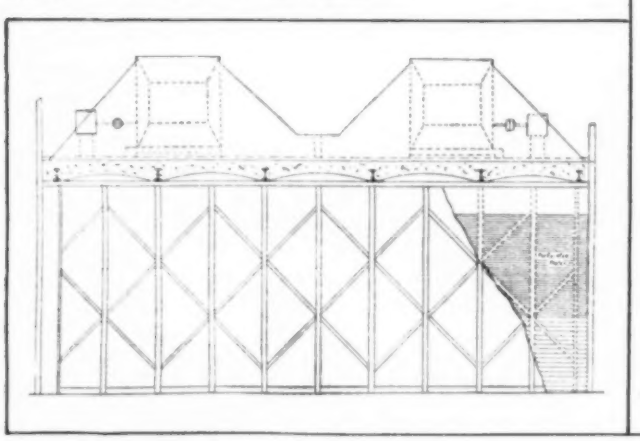
Eliminates Surface Cracks

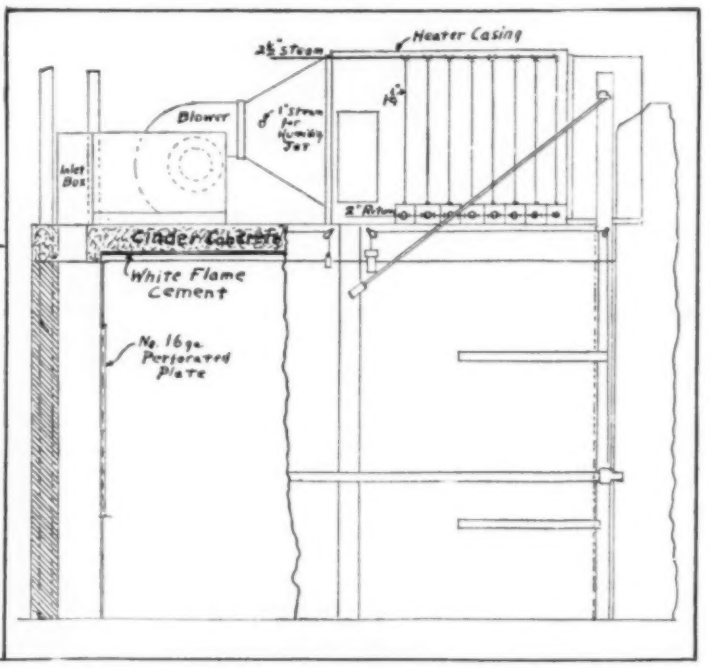
By George Wright and J. M. Sampson

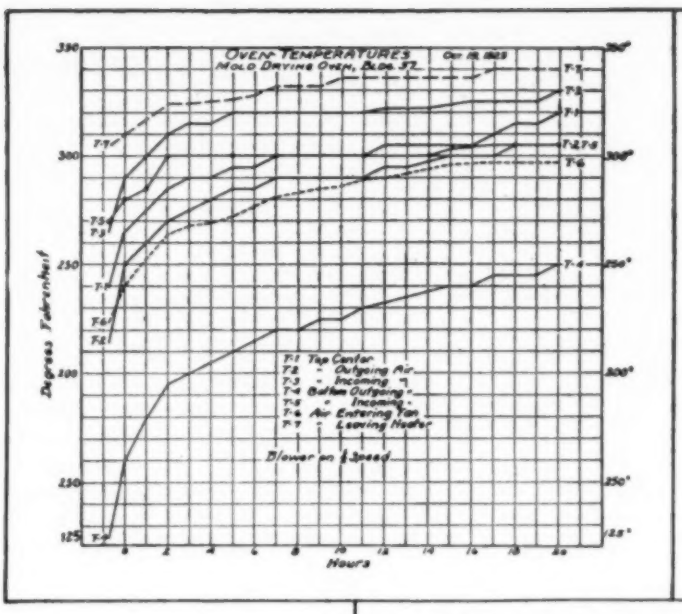
NEARLY four years ago it became necessary to build an additional large car type mold drying oven in the steel foundry of the General Electric Co., Schenectady, N. Y. Plans of the usual type of oil-fired oven were submitted for approval, but before acceptance could be obtained, the question arose as to whether or not the principles used in drying porcelain and other materials could be incorporated. This involved drying in a more or less humid atmosphere, and keeping up a fairly brisk circulation of the atmosphere within the oven, at least during the major portion of the drying time.

Preliminary tests in a small oven 7 feet square by 8 feet high were made and showed promise. Later tests were made on a larger oven, and

Fig. 2 (Below)—Side Elevation of Core Oven. Fig. 3 (Right)—End elevation







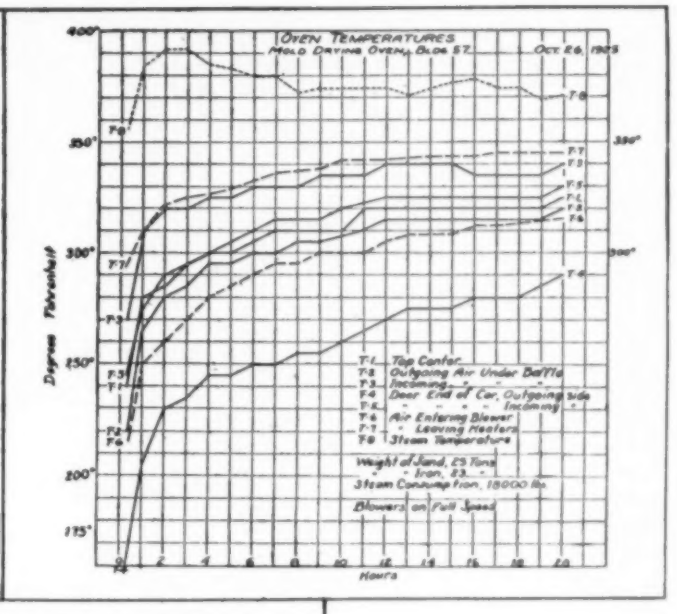


Fig. 4 (Above)—Temperatures in Various Parts of the Oven During the 20-Hour Run, Blowers Being Run at Half Speed. Fig. 5 (Right) Oven Temperatures During 20-Hour Run, Blowers at Full Speed

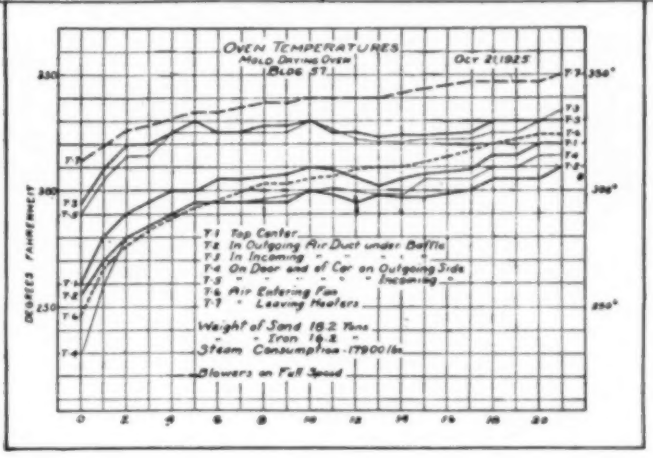

OVEN TEMPERATURES
MOLD DRYING OVEN
BLDG. 57
OCT. 21, 1925
DEGREES FAHRENHEIT
T-1 Top Center
T-2 In Outgoing Air Duct under Baffle
T-3 In Incoming " " " "
T-4 On Door end of Car on Outgoing Side
T-5 " " " " " Incoming "
T-6 Air Entering Fan
T-7 " Leaving Heaters
Weight of Sand 18.2 Tons
" Iron 19.2 "
Steam Consumption-17900 lbs.
Blowers on Full Speed

Fig. 6 (Above)—Chart Showing the Temperatures in an Oven During a 20-Hour Run with Blowers at Full Speed

seemed to show promise. Later tests were made on a larger oven, and after two years of experimental tests the company proceeded with the design of the present large oven. This oven is approximately 16 feet wide, 30 feet long, and 11 feet 6 inches high, inside dimensions.

Walls are 8-inch gypsum block, with 1-inch white flame plaster inside and 1-inch gypsum plaster outside. The roof is composed of 12 inches of cinder concrete, the floor is 12 inches of concrete on top of dirt base. Doors are 4-inch channel frames, covered with sheet metal and filled in between with a patented insulating brick.

The side walls contain ducts through which the air passes, down on its way to the interior of the oven and up as it returns to the fans and steam heating coils. The interior wall of this duct is composed of perforated steel plates as indicated on the drawings shown. On top of the oven these ducts are connected by well insulated conductors of two fan blowers type used for heating factory buildings. The air is heated in these two heat exchangers and is forced down the hollow wall or duct, and across the surface of the molds to the duct within the opposite wall.

When the steam heat first is turned on and the blowers started, steam is injected into the oven until the temperature of the center of molds reaches 180 degrees Fahr. This varies from

Editor's Note—This article is abstracted from a paper presented at the Chicago convention of the American Foundrymen's association. The authors are connected with the foundry department of the General Electric Co., Schenectady, N. Y.

Presents Summary of Tests on Ovens

Steam Heated Oven

Date, 1925	10/5	10/6	10/7	10/8	10/9
Hours run	21.27	22.11	21.13	21.00	15.92
Weight of sand, tons	22.15	14.14	24.53	28.25	18.06
Weight of iron, tons	26.00	25.30	29.60	37.87	29.29
Total weight, tons	48.15	39.44	54.13	66.12	47.55
Total pounds steam used	16,177	15,063	15,250	15,714	11,700
Average steam per hour	760	682	720	748	734
Total cost of steam	$7.44	$6.93	$7.01	$7.23	$5.38
Cost per ton of sand	$0.335	$0.49	$0.286	$0.255	$0.297
Dummy Mold Data:					
Per cent water in sand	6.5	6.1	7.0	7.2	.....
Depth of drying, inches	5	6	4	4.5	.....
Temperature at center, degrees Fahr.	212	212	212	212	.....
Hours to reach this temperature	14	13	15	18	.....
Per cent moisture at finish:					
2 inches deep	0.0	0.0	0.0	0.0	.....
6 inches deep	1.0	0.3	1.0	1.2	.....
10 inches deep	3.6	3.1	3.9	4.0	.....

Oil Fired Oven

Date, 1925	4/20	4/21	4/22	4/24
Hours run	16.00	16.00	16.66	16.16
Weight of sand, tons	18.20	21.80	27.20	32.60
Gallons oil burned	251	254	273	330
Average gallons per hour	15.6	15.8	16.4	20.4
Total cost of oil	$17.57	$17.78	$19.11	$23.10
Cost per ton of sand	$0.965	$0.815	$0.703	$0.708

Dummy Mold Data

Per cent moisture at finish	Cold part	Hot part
2 inches deep	0.0	0.0
6 inches deep	1.8	1.0
10 inches deep	4.0	3.3

Cost Summary

	Steam heat	Oil fired
Average cost heating per run	$6.80	$19.39
Average cost per ton of sand	$0.317	$ 0.775

2 to 4 hours. This humidity prevents the skin or surface of the mold dying and assures a steady flow of moisture from the interior of the mold to the surface by capillary attraction.

During October, 1925, a series of tests were made on this oven as well as on an oil-fired oven of same size located adjacent to it. A recording flow meter was installed in the steam line leading to the heating coils, and the discharge line leading from the steam traps was carried to the outside of the building into two barrels placed on scales. A small condenser was inserted in the line for cooling the condensate before it emptied into the barrels. The amount of steam consumed was found both by weighing the condensate and by integrating the flow meter charts. The amount of steam consumed as shown by the flow meter was 1.2 per cent higher for the week than that found by weighing the condensate.

Thermocouples were installed at different points in the oven and in a dummy mold which gave results as shown in the summary of oven tests. The dummy mold was 36 inches square and 20 inches high and was placed on the frame of the car in the corner away from the incoming air, so that it would be in the least advantageous position as regards drying.

The temperature readings in the mold were taken at the vertical center, 2, 6 and 10 inches below the surface or top of the mold.

Readings of air temperatures within the oven were taken at the top center, in the corners of the oven 18 inches from the floor and 2 feet from the doors, and also of the incoming and outgoing air in the ducts.

The weights of sand and iron, including cars, flasks, bottom plates, etc., in each charge were obtained by careful calculations of the cubical contents of these materials.

The oven is equipped with a vent pipe which is closed by a butterfly damper. This damper was closed during all the tests. Steam is piped to the inside of the heater casing for supplying steam to humidify the air.

The original speed of the motors which were direct connected to the fans was 1100 revolutions per minute. During these tests the speed was reduced to 550 revolutions per minute for experimental purposes and it was found that the condition of the molds were not quite as dry as obtained from the higher speed. Consequently it was found necessary to return to the higher speed. A summary of the tests is given in the Table. Additional data is given in the charts shown in the other illustration.

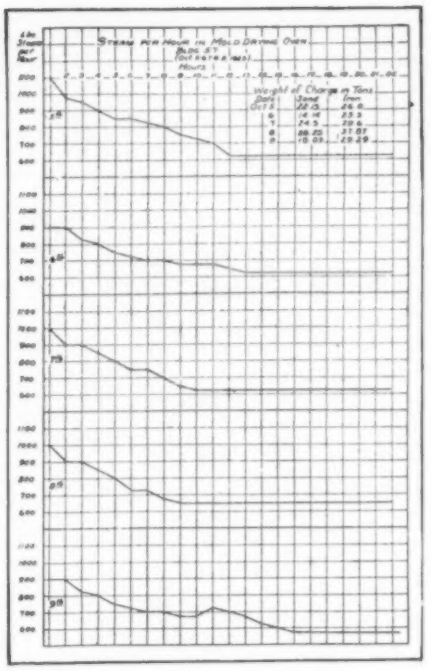


FIG. 7—POUNDS OF STEAM PER HOUR DURING 22-HOUR RUNS

Steam was used for heating the circulating air in this oven for various reasons. One was because the steel foundry is adjacent to the main boiler room of the plant, and also because, with the steam temperature running approximately 375 degrees Fahr., it would be impossible to overheat the sand molds.

It is recognized that many foundries would not have steam available in sufficient quantity or with sufficient superheat. However, it is perfectly feasible to heat the circulating air by means of indirect heating, using oil as fuel. Thermostatic control of the oil burner to prevent the oven temperature from exceeding 350 degrees Fahr. should be provided, and provision made to introduce steam into the air current at a convenient point; this steam could be low pressure as well as not.

Effect on Molds and Castings

It has been found that a given mold can be dried in nearly the same time interval, leaving practically the same or less residual moisture at a given depth, in this new oven as in the older oil-fired oven. But there is no comparison between the surfaces of the molds dried in the new oven, with those dried in the older ovens. There is an entire absence of cracks in the surface of the silica wash coating, and even if one scratches away this silica wash, the sand below is found well bonded and free from any tendency to wash away with the metal during pouring.

The discounts in this foundry are running below 1.75 per cent of castings shipped, and it is seldom that a casting made in a mold dried in the new oven is found in the discount list due to mold cutting, scabbing, and other causes which can possibly be attributed to improper drying.

Definitions in Heat Treating Approved

(*Concluded from Page* 631)

is a type of annealing operation with slow cooling whereby combined carbon in white cast iron is transformed to temper carbon and in some cases the carbon is entirely removed from the iron. Note: Temper carbon is free carbon in the form of rounded modules made up of an aggregate of minute crystals.

E. GRAPHITIZING—*Graphitizing is a type of annealing of cast iron whereby some or all of the combined carbon is transformed to free or uncombined carbon.*

5. CARBURIZING (Cementation)—*Adding carbon to iron base alloys by heating the metal below its melting point in contact with carbonaceous material.* Note: The term "carbonizing" used in this sense is undesirable and its use should be discouraged.

6. CASE HARDENING—*Carburizing and subsequent hardening by suitable heat treatment, all or part of the surface portions of a piece of iron base alloy.*

CASE—*That portion of a carburized iron base alloy article in which the carbon content has been substantially increased.*

CORE—*That portion of a carburized iron base alloy article in which the carbon content has not been substantially increased.*

The terms "Case" and "Core" refer to both case hardening and carburizing.

7. CYANIDING—*Surface hardening of an iron base alloy article or portion of it by heating at a suitable temperature in contact with a cyanide salt, followed by quenching.*

Officers Are Elected

American Society of Mechanical Engineers, Erie, Pa., section, has elected officers for the year. Macdonald S. Reed, Erie Foundry Co., has been made chairman; George W. Nigh, Erie City Iron Works, vice chairman; W. J. Brenner, Lakeview Drop Forge Co., secretary; Frank H. Derby, Erie Foundry Co., treasurer; George W. Bach, Union Iron Works, Erie technical federation committee.

Stops Crack in Monel Casting

Many Methods Were Tried in Vain Before a Satisfactory Combination Was Adopted To Prevent the Casting from Cracking in the Web After It Was Poured

By R. J. Walker

ALTHOUGH apparently a simple casting the monel metal piston for an oil meter 12 inches diameter shown in section in Fig. 2 not only puzzled the staff of the foundry specializing in meter castings, but also proved too much for several outside foundries which enjoy a well deserved reputation for turning out satisfactory castings.

The casting resembled a small web pulley 12 inches outside diameter, 8-inch face, 1¾-inch hub, 6 inches in length with a 1-inch diameter core through the center. The web was ⅜-inch thick, thickly perforated with ½-inch holes arranged in circles, also with one comparatively large pear shaped opening 2 x 4 inches as shown in Fig. 3. The rim was ⅞-inch in thickness.

Defect in this casting did not appear until it was partly machined. Then a crack was found at the junction of the rim and the web. In some castings the crack only extended one quarter of the distance while in others the crack extended one half way round the circumference. The defect readily was recognized as a *draw* due to inequality of setting time between the web and the rim. However, as foundrymen in general are aware, recognizing a defect and providing a remedy are two different things. The first is comparatively simple. The second sometimes becomes a costly problem.

The words *draw* and *shrink* are not synonymous terms, although careless foundrymen sometimes use them in that manner. According to Webster *draw* means to pull; *shrink* means to make less. From this it is apparent that a draw (when applied to castings) means an arrested construction resulting in a fracture. A shrink means a seepage of metal while in a molten condition resulting in a cavity. In this particular instance the problem was to facilitate the contraction of the rim so that it would follow that of the web.

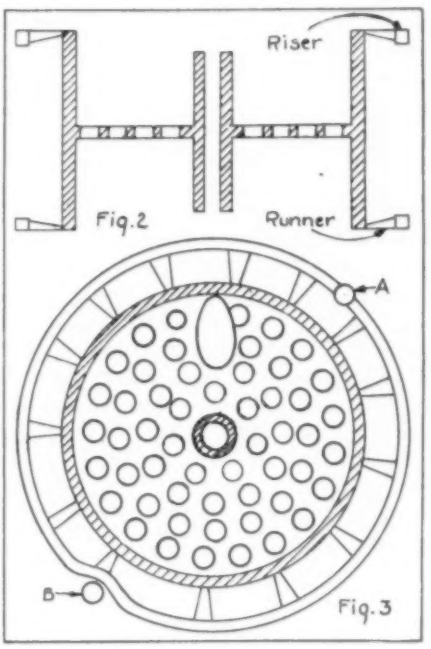


FIG. 2—ABOVE SECTIONAL VIEW OF PISTON CASTING. FIG. 3—BELOW PLAN OF SAME CASTING SHOWING POSITION OF GATE AND RISER

Practically every size, shape and combination of gates and runners were tried without success until we hit upon the circular spray gate shown in Fig. 3. Metal was poured into a cup placed on a strainer core and the head was kept up full. The runner *B* Fig. 3 extended to the bottom of the cheek. The series of inlets permitted an easy, even flow of metal all around into the mold. A similar style of spray gate on the upper side of the cheek with an upright at *A* carried off dead metal, gas and any impurities that might have been present. About ½-inch head metal was placed on the hub.

The theory back of this style of gating was that the dull metal in the upper ring would set first and exert an inward pressure on the rim of the casting. Pouring temperature of the metal is in excess of 3000 degrees Fahr.

After trying various combinations, the facing sand that gave the most satisfactory service was made up of one part Jersey fire sand and two parts No. 2 Albany sand. Not new sand, but sand taken from the heap originally made up of No. 2 Albany sand. The mixture was wet down with weak molasses water. This facing sand presented a minimum amount of organic material, consequently caused no disturbance when exposed to the heat of the metal.

The mold was made in a 20-inch square steel flask, with a 4-inch deep cope, a similar drag and a cheek 8 inches deep. The comparatively large flask was chosen deliberately to make room for the special gate and the mold cheeked off so that all the surfaces might be sprayed with black lead mixed with molasses water.

Method of making the mold differed to some extent from the usual routine. The entire pattern was placed on the rollover board and the cheek and drag were rammed first. A gate stick was placed in one corner of the cheek and the space between the rim of the pattern and the flask was rammed full of sand. The inside of the pattern then was faced, partly filled with cinders and rammed to the top. A parting was made flush with the bottom edge of the pattern and the edge of the cheek. The drag then was set in place, a screw was attached to the hub core print and the drag was filled and rammed in the usual manner. Both parts were clamped and rolled over. The cope was rammed in a similar manner

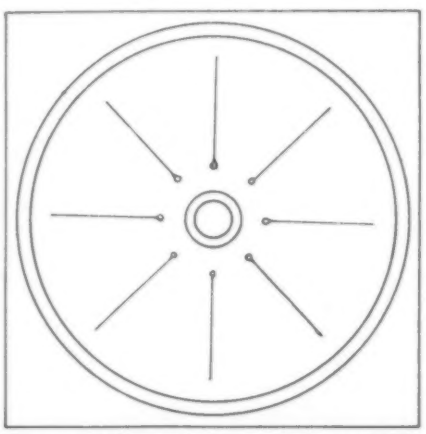


FIG. 1—RIGHT WAY TO SET GAGGERS

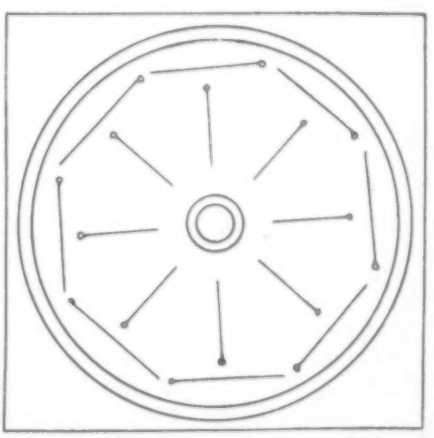


FIG. 4—WRONG WAY TO SET GAGGERS

with a thickness of facing sand next the pattern, a few gaggers to carry the suspended body of sand and a cinder ring to facilitate venting and contraction. A minimum number of gaggers were employed and they were placed as shown in Fig. 1 to offer the least resistance.

A small block of wood similar in shape and size to the strainer core was rammed in one corner over the gate pin in the cheek. The top of the cope was scraped off flush and a sprue was punched through at two opposite corners. One for the gate and one for the riser. The one for the runner was reamed out to engage all the holes in the strainer core. Two additional holes were punched from the top of the cope down to the cinders.

Lift the Pattern

The entire mold then was clamped and rolled over. The bottom plate was removed temporarily. Two holes were punched down to the cinder bed and a rod was passed through the eye of the screw attached to the hub core print. The rod was wedged up on the edges of the drag and then the cheek, drag and pattern were lifted as a unit away from the cope. In this manner no load was placed on the gaggers while the sand was green. After the mold was dried, the small number of gaggers supported the sand easily. The drag and cheek were set down in their proper position. The pattern was drawn out of the cheek and then the cheek was lifted away from the drag. All the surfaces were sprayed with blacking and the three parts of the mold were dried separately in the oven. On the following day the mold was assembled and made ready for the metal.

While the metal was in the furnace it was covered with a proprietary flux and shortly before it was removed, a deoxidizer to the extent of 1.00 per cent made up of equal parts zinc and copper was added. An ounce of prevention is worth a pound of cure. A deepener was placed around the top of the crucible and all the metal was charged at one time. The bottom of an old crucible was placed on top of the deepener. The metal covered with flux practically was immune from contamination.

Over 5 hours elapsed for the first crucible in an oil fired furnace that attains a temperature of 3500 degrees Fahr. The second charge, 225 pounds of metal in a No. 80 crucible melted in 3 to 3½ hours. A few handfulls of sand stirred vigorously into the slag on top of the metal prevented the slag from entering the runner. Experience has shown the advantage of leaving a slight covering on the metal instead of skimming it clean and exposing it to the atmosphere.

Ohio State Foundrymen Arrange Features

The seventh annual convention of the Ohio State Foundrymen's association which will be held at Cedar Point, O., on Aug. 19 and 20 will afford those attending an excellent opportunity to combine business and pleasure. In addition to the speakers mentioned in the Aug. 1 issue of THE FOUNDRY, Arnold Lenz, Saginaw Products division, General Motors Corp., Saginaw, Mich., will speak on "Quality, Quantity and Economy in Castings." Headquarters of the association will be established at the Breakers hotel. Friday, Aug. 19, will be devoted to registration and committee meetings in the morning and technical sessions in the afternoon. The annual banquet will be held in the evening with Stuart Wells Utley, president, American Foundrymen's association as the principal speaker. Following the banquet a reception and dance will be held. Saturday, Aug. 20, will be devoted to business sessions.

Entertainment has been arranged for the ladies attending the convention. On Friday they will visit points of interest at Cedar Point and on Saturday a luncheon will be served followed by cards, entertainment and refreshments. Committees in charge of the various arrangements are as follows: Reception, M. L. Spackman, Henry Furnace & Foundry Co., Cleveland, chairman; J. L. Morrow, Burch Plow Works, Crestline, O.; Nelson Abbey, Etna Machine Co., Toledo, O.; L. J. Tillman Industrial Steel Castings Co., Toledo, O.; George Walton, Madison Foundry Co., Cleveland; W. O. Larsen, Cuyahoga Foundry Co., Cleveland; O. J. Blank, Peck, Stow & Wilcox Co., Cleveland; A. B. Hamilton, Norwalk Foundry Co., Norwalk, O.; Roy Ensign, Ensign Foundry Co., Toledo, O.; O. F. Rinderle, Brown Clutch Co., Sandusky, O.; William Huston, Xenia Foundry Co., Xenia, O. The ladies' committee is composed of Mrs. W. L. Seelbach, chairman; Mrs. F. W. Huber; Mrs. A. A. Nolte; Mrs. C. C. Smith; Mrs. D. McDaniel and Mrs. A. J. Tuscany.

J. F. Walton, West Park Foundry Co., Cleveland, chairman of the entertainment committee will be assisted by A. M. Siess, W. S. Tyler Co., Cleveland; Mr. Hosler, Model Foundry & Machine Co., Findlay, O.; T. C. Alfred, Hocking Valley Mfg. Co., Lancaster, O.; Howard Greenbaum, Acme, Palmer & DeMooy Foundry Co., Cleveland; Dan Gluntz, Gluntz Brass Foundry Co., Cleveland, and Cyril Brecknock, Lorain Castings Co., Lorain, O. J. E. Carroll, G. & C. Foundry Co., Sandusky, O., will take care of the golfers. The nominating committee will be composed of J. E. Carroll, G. & C. Foundry Co., Sandusky; Ray Redmond, Buckeye Foundry Co., Cincinnati, and M. Hertenstein, M. Hertenstein Foundry Co., Columbus, O. E. A. Leary, Cincinnati Steel Casting Co., Cincinnati, has been appointed to prepare resolutions.

Can Eliminate Difficulties

Following the preliminary survey of foundry coke which was explained in detail in the July 15 issue of THE FOUNDRY, R. M. Hudson, chief of the simplified practice division, department of commerce, sent a summary of the facts presented in that article to foundrymen and other interested people. This has resulted in many interesting replies including the following from a consulting engineer:

"* * * quite a lot can be done by producers to arrive at a grade of coke which will give satisfaction to the foundryman * * *. The specifications, quite a lot of them as I am somewhat surprised to see from your list, nevertheless will be found not far apart in their requirements, and could be standardized easily if the several foundry bodies and producers would get together.

"However, there is another point involved of which foundrymen do not think especially. This is that the foundrymen can reduce his chances for trouble with coke materially if he would charge his cupola with due regard to the possibility of his receiving car loads of coke with varying physical properties. He can do this by making his charges small and digging into his coke pile in such a way as to obtain average material and not large pieces one time and small the next. * * * In one instance, I had them reduce the iron charges to one third, and level off each charge as well as they could with a hook. Excellent castings were obtained with light, by-product coke.

"So you see, complaints of foundrymen about too great variety of coke standards, while entirely justified by facts when physical structure is taken into account, could be reduced considerably by initiating a rational charging system which would overcome most of the difficulties in the first place."

Casts Large Pipe
CENTRIFUGALLY

Application of Process in Production of 35-Inch Pipe Described—Reviews Adaptability to Production of Castings in Steel and Various Nonferrous Alloys

By J. E. Hurst

CENTRIFUGAL casting methods have attracted many eminent engineers and inventors in Great Britain and other countries. Their greatest success has been made during the last decade in the extensive application to the production of cast iron pipes. The developments of Millspaugh, Sens and de Lavaud and Moore in America, of Stokes and Hurst-Ball in England, Gelsenkirchen and others on the continent, are familiar to those interested in this subject.

The de Lavaud process mentioned is in operation in England at the works of the Stanton company, near Nottingham, and at the works of the Compagnie Generale des Conduites d'Eau at Liege, Belgium. The former plant is the largest unit plant in operation under this system. Since its inception up to November, 1925, it has manufactured and supplied 1673 miles of pipes. In Germany the Gelsenkirchen company is operating under the Briede patents and other systems are in the development stage.

Characteristic Feature

The process of which the writer is the joint inventor, namely the Hurst-Ball process, is under development in its application to the production of pipes at the works of Newton, Chambers & Co., Ltd., Thorncliffe Ironworks, Sheffield, England.

It is of some interest to note that what is probably the largest centrifugal casting yet produced in cast iron, a 33-inch diameter spigot and socket pipe, weighing approximately 2 tons, has been made on the Hurst-Ball machine during the experiments at Kilmarnock, Scotland.

Mechanical details of the various processes as applied to the production of pipes have been described generally in various technical publications. The characteristic feature of the de Lavaud system is the fact that the pipes are rendered free from chill by subjecting them to an annealing treatment subsequent to their removal from the mold. At the works of the Stanton company this annealing treatment is carried out in specially designed continuous annealing furnaces equipped with waste heat recovery.

In the de Lavaud system as operated at Conduites d'Eau this annealing treatment has been eliminated and the pipes are produced direct in a freely machinable condition free from chill. A British patent, No. 242617, in the name of this company describes the improvements for *making unhardened iron castings.* The essential feature of this patent is that the mold is lined with silicon, ferrosillicon, or other silicon containing substance mixed with a suitable adhesive and applied by a brush, atomizer or a form of separate pouring trough.

In the Hurst-Ball system the castings are produced free from chill without any annealing treatment. This is effected by using hot molds, the temperature conditions of which are maintained by the actual production of castings. While atmospherically cooled molds are at present in use the correct temperature conditions can be maintained with the use of a liquid cooling medium such as water.

Chemical composition of the iron used in the Stanton-Lavaud pipes is given in Table I. The cast iron is remelted in cupolas and is not used direct from the blast furnaces. The importance of the chemical composition has been commented upon by the Stanton company and at the present stage it appears to be somewhat uncertain as to whether sufficiently accurate control can be exercised over the composition of direct blast furnace metal for the centrifugal casting process.

Pipes Are Tested

In the Hurst-Ball process a No. 3 Scotch iron having a somewhat lower silicon content has been used in the experimental work on pipes. The chemical composition of this iron is that given in Table II. The lower silicon and phosphorus contents of this material are responsible for slightly improved physical and mechanical properties.

Strength properties of pipes cast by the de Lavaud process have been exhaustively investigated. The tests made were carried out on actual pipes and on the material itself. Actual pipes and samples cut from pipes were tested to destruction under different systems of loading, viz.: (1) internal bursting pressure, (2) external collapsing pressure and (3)

Describes Methods

APPLICATION of the centrifugal process to the production of pipes in Great Britain and other countries by the de Lavaud methods is described, also observations are included on the development of other centrifugal pipe casting methods. This article is an abstract of a paper presented at the Detroit convention of the American Foundrymen's association.

J. E. Hurst, author of this article, is the joint inventor of the Hurst-Ball centrifugal casting process and is the managing director of Centrifugal Castings, Ltd., Kilmarnock, Scotland. The Hurst-Ball system has been acquired by Newton, Chambers & Co., Ltd., Thorncliffe Iron works near Sheffield where Mr. Hurst is in charge of further developments of this system. Mr. Hurst is a foundry metallurgist and is well known in foundry circles as the author of various papers on the constitution and properties of cast iron.

J. E. Hurst

transverse bending. Specimens of material cut from pipes also were submitted to transverse, direct tensile and other tests. A summary of the test results obtained and a comparison with sand cast pipes is included in Tables III and IV.

As a result of the improved mechanical properties the Stanton company has been able to reduce the radial thickness of the centrifugally cast pipes below the British standard specification requirements to such an extent as to produce pipes 20 to 25 per cent less in weight than that demanded in the British standard requirements.

It is of importance to bear in mind that the mechanical test figures have been obtained on material cast by the de Lavaud process after having been subjected to the standard annealing treatment. Certain of these figures are interesting to compare with those obtained on direct castings by the Hurst-Ball system which is accomplished without any annealing treatment.

Table I

Analysis of Pipe

	Per cent
Total carbon	3.5
Graphitic carbon	3.0
Combined carbon	0.5
Silicon	3.0
Manganese	0.35
Sulphur	0.075
Phosphorus	1.20

Apart from the improvement in mechanical properties the use of the centrifugal process is accompanied by considerable improvements in the quality of the pipes. As a result of the centrifugal pressure the pipes are free from blowholes and internal defects, and the use of a metal mold results in the production of pipes of greater uniformity and to closer limits of dimensions. Even in large diameter pipes, upwards of 2 tons in weight, a maximum total variation in weight of 2½ per cent can be maintained readily. The absence of sand as a molding material also tends to increased soundness in the castings and the pipes are invariably free from adhering sandy skins.

Table II

Analysis of Pig Iron

	Per cent
Total carbon	3.75
Graphitic carbon	3.15
Combined carbon	0.60
Silicon	2.75
Manganese	0.75
Sulphur	0.075
Phosphorus	0.75

The centrifugal process has been extensively developed in Great Britain for the production of cylindrical castings in gray iron piston rings, sleeve valve liners and engine cylinder liners. Production of castings by the centrifugal process for this purpose has been in operation on a commercial basis in Great Britain for the past ten years.

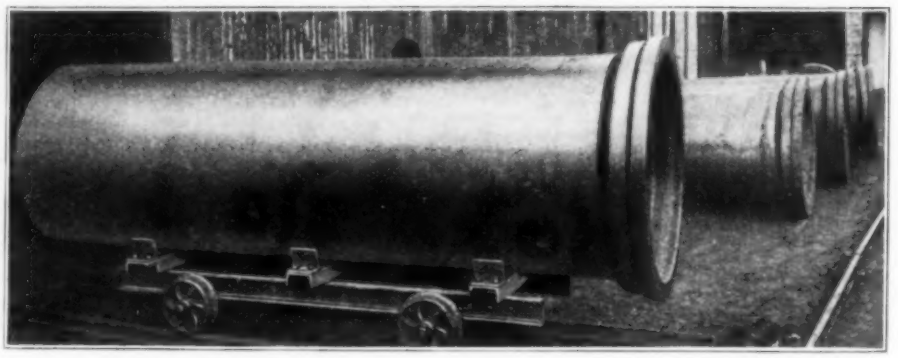


FIG. 1—GROUP OF 33-INCH DIAMETER BELL AND SPIGOT WATER PIPE CAST ACCORDING TO THE HURST-BALL SYSTEM

Permanent metal molds are used in all cases, the castings are produced directly machinable without any subsequent annealing. The rotating molds are maintained cool naturally, or atmospherically, and as far as the writer is aware water cooling of the molds or any other form of cooling other than atmospheric has not been utilized for this purpose.

To meet the requirements of piston ring makers, drum castings are made from 2 inches up to 48 inches diameter. A complete range of standard sizes of drum castings within these limits has been drawn up which is practically accepted by all the manufacturers of piston rings. The standardization of the castings enables the centrifugal process to operate on economic lines.

Chemical Composition

In addition to piston ring drums other varieties of cylindrical castings are produced in a similar manner. Among these are sleeve valve liners for the various types of automobile engines, piston valve liner castings for locomotives, cylindrical liner castings for locomotives, gas, oil and diesel engines. A photograph showing a typical group of sleeve valve liner castings produced by the Hurst-Ball process is illustrated in Fig. 2. This process is able to produce cylinder liners up to 36 inches diameter by 120 inches long.

This subject has been extensively

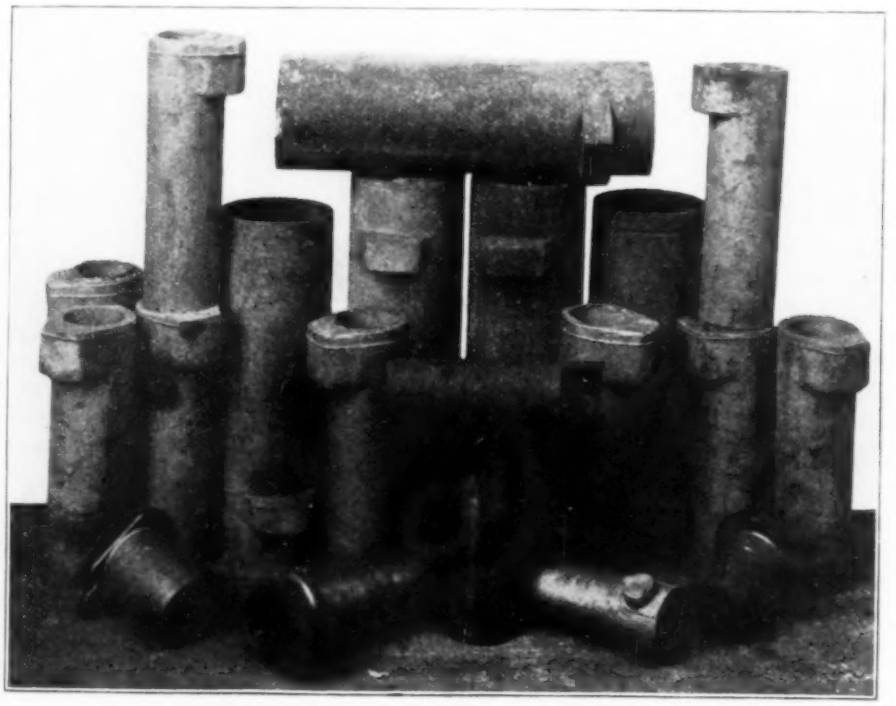


FIG. 2—GROUP OF SLEEVE VALVE CASTINGS WITH IRREGULAR PROJECTIONS ON THE ENDS CAST IN CENTRIFUGAL MOLDS

SPECIFICATIONS FOR SCRAP METAL

FOR USE IN GRAY IRON FOUNDRY PRACTICE

No. 1 Machinery Cupola Scrap

Clean machinery cast iron scrap. Must be cupola size, not over 30 inches in any dimension and no piece to weigh over 150 pounds. Clean mine car wheels, free from dirt and grease will be accepted.

No. 1 Machinery Breakable Scrap

Clean machinery cast iron scrap, weighing over 150 pounds and which may be easily broken by an ordinary drop into cupola size.

No. 1 Common Cupola Scrap

Clean cast iron scrap, such as columns, pipes, plates, and castings of miscellaneous nature, but free from stove plate and agricultural scrap. Must be cupola size, not over 30 inches in any dimension, and no piece to weigh over 150 pounds. Must be reasonably free from foreign material.

No. 1 Common Breakable Scrap

Clean cast iron scrap, such as columns, pipes, plates, and castings of miscellaneous nature, weighing over 150 pounds and which can be easily broken by an ordinary drop into cupola size.

Burnt Cast Scrap

Burnt cast iron scrap, such as grate bars, annealing boxes, stove parts, and any miscellaneous burnt scrap. American Railway association classification No. 18 will be acceptable.

Stove Plate Scrap

Clean cast iron stove plate. Must be free from malleable and steel parts, window weights, plow points, grates, burnt iron, etc.

Agricultural Scrap

Cast iron parts of agricultural machinery, including plow points. Must be free from steel, malleable and full chilled iron.

Cast Iron Car Wheels

Clean, chilled cast iron car wheels, conforming to Master Car Builders specifications. American Railway association classification No. 54 will be acceptable.

Brake Shoes

Driving and car brake shoes of all types, except composition filled shoes. American Railway association classification No. 19 will be acceptable.

Abstracted from the revised specifications covering iron and steel scrap which were adopted tentatively for one year by the National Association of Purchasing Agents.

(*Continued on Data Sheet No.* 682)

SPECIFICATIONS FOR SCRAP METAL

(*Continued from Data Sheet No.* 681)

No. 1 Radiator Scrap

Broken radiator castings, with all steel, malleable and other parts removed. Must be free from excessive scale, rust and corrosion.

No. 2 Radiator Scrap

Unbroken radiator castings, with all steel, malleable, and other parts removed. Must be free from excessive scale, rust and corrosion.

No. 1 Malleable Scrap, Air Furnace Practice

Malleable parts of automobiles, railroad cars and miscellaneous malleable castings, weighing 10 pounds and over. Must have undergone the annealing process. Must be free from steel, gray and cast iron parts. American Railway association classification No. 30 will be acceptable.

No. 2 Malleable Scrap, Air Furnace Practice

Malleable parts of agricultural implements, and other miscellaneous malleable castings, under 10 pounds in weight. Must have undergone the annealing process. Must be free from steel and cast iron parts.

Cupola Malleable Scrap

Malleable parts of agricultural implements, automobiles, railroad cars and similar miscellaneous malleable castings, suitable for cupola charging. Must have undergone the annealing process. Must be free from steel and cast iron parts.

FOR USE IN BESSEMER CONVERTERS

Mild Steel Converter Scrap

Mild open hearth steel scrap, such as structural shapes, rolling mill crop ends, forgings and forge crop ends. No piece to weigh over 150 pounds or less than 10 pounds, not under ⅜-inch section, and must not exceed 24 inches in any one dimension. Must be free from excessive rust or corrosion.

High Carbon Steel Converter Scrap

High carbon or hard steel scrap, such as steel rails and material of similar analysis. No piece to weigh over 150 pounds or less than 10 pounds and must not exceed 24 inches in any one dimension. Must be free from excessive rust or corrosion.

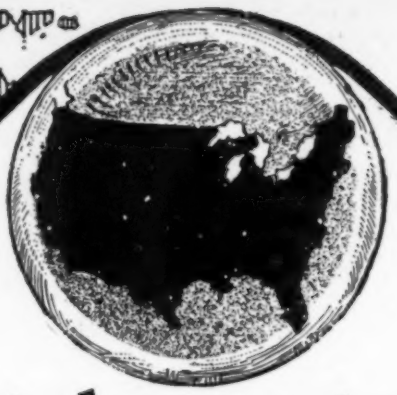
Steel Spring Scrap

Coil and leaf springs, made from stock ⅜-inch in thickness or heavier. Elliptical springs must be cut apart, and must not exceed 24 inches in length. Must be free from plates, and from excessive rust or corrosion.

THE FOUNDRY DATA SHEET, AUG. 15, 1927

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.



Seeing America with The Foundry

Little Journeys to the homes of our readers

MAINE has a total of 30 foundries of which

27 Melt Gray Iron
3 Exclusive Nonferrous
19 Nonferrous Departments of other Foundries
19 Aluminum

MAINE—the Pine Tree State is, in reality, the vacation state. Starting with May, when the ice goes out of the lakes and the fishing opens, until December when the heavy snows make hunting impossible, this state provides a wonderful playground. The state as a whole is one of the most beautiful regions east of the Mississippi, with its fragrant evergreen forests, diversified by hundreds of clear, cold lakes, its verdure-clad hills, its rapidly-flowing rivers with their picturesque waterfalls, and its rugged coast fringed with islands. There are over 1,500 lakes, many of which are famed for their beauty and for their excellent fish. The most noted of these is Moosehead Lake, in the west-central part of the state. It has an area of 120 square miles, and is the largest inland lake in New England.

Extensive water power has made Maine an important manufacturing state and shipbuilding is one of the leading industries. Bath at one time was the chief shipbuilding center of the United States and held this position for one hundred years. Lewiston, Biddeford and Saco are very extensively engaged in the manufacture of cotton goods. Immense quantities of paper and wood pump are manufactured in Maine, while other important manufactures are woolens, leather, boots and shoes, flour and lumber products.

The river valleys in Aroostook County are exceptionally fertile regions and in this particular section alone more than 17,000,000 bushels of potatoes are raised annually. Maine also produces a superior quality of sweet corn, and apples are grown in nearly all parts of the state in abundance.

In MAINE THE FOUNDRY has 19 paid subscribers

"Wherever metals are cast you'll find THE FOUNDRY"

Table III

Tests on Pipe Material

Mean Values in All Cases

	Centrifugal	Sand
Tensile strength from ring test	59,768 pounds	45,025 pounds
Modulus of rupture	15,870,086 pounds	13,910,000 pounds
Modulus of elasticity	41.30 hundredweight	29.3 hundredweight
Equiv: Load on 2" x 1" x 36" bar	18.71 tons per sq. in.	10.37 tons per sq. in.
Direct tensile strength	18.86 tons per sq. in.	10.80 tons per sq. in.

studied with particular reference to small castings for automobile piston rings, by a subcommittee of the British Engineering Standards committtee. The physical and mechanical requirements of piston rings are concerned with the ultimate breaking strength of the material and the absence of *flabbiness* or lack of springiness. In addition to studying the actual breaking strength of cast iron in the form of piston rings these investigations have necessitated a study of the relation between chemical composition, permanent set and modulus of elasticity. The limits of chemical composition for centrifugal castings are those given in Table V.

Physical and Mechanical Properties

In actual practice the lower limits of the specification as far as silicon contents are concerned are worked to and a typical composition of the writer's own product is shown in Table VI. This composition is confined to automobile piston ring drums which never exceed 10 millimeters in radial thickness. These castings are produced directly from metal molds without any annealing and are capable of being machined at a guaranteed minimum machining speed of 30 feet per minute. In fact, so far as experiment teaches us at present, annealing at temperatures above the pearlite point destroys the *springiness* characteristics. Short annealing at low temperatures of 450 to 500 degrees Cent. improves the springiness.

Mechanical and physical properties of centrifugally cast piston ring drums are considerably superior to those of similar drums sand cast. A typical series of results obtained are given in Table VII. The additional advantages of centrifugal castings over sand castings for these general purposes are (1) their freedom from sand and hard sandy skins, (2) their uniformity of dimensions, (3) the absence of blow holes and internal unsoundness. The value of these advantages in the intensive machining of piston rings needs no further elaboration.

Investigation is in progress on the resistance to wear of centrifugally cast material. It has been found of considerable importance to maintain as high a combined carbon value as possible to obtain high resistance to wear, and on no account should this be less than the minimum value given in the standard specification.

Results of some experiments on the comparative resistance to wear of centrifugal and sand cast material are of interest and are given in Table VIII. Both samples tested were of the same material from the same ladle, and the tests were made under comparative conditions.

In the initial stages of the wearing action the rate of wear is greater in the centrifugal casting than in the sand casting. The centrifugal casting appears to attain a condition in which the rate of wear becomes of a constant low value, and over the duration of this test the total wear in the sand casting is nearly twice that of the centrifugal casting.

Making Cylinder Liners

For thicker castings such as large piston ring drums and cylinder liners the thickness of which exceed 0.75 inches, lower silicon content is used. We are able to produce castings directly machinable with a silicon content as low as 1.5 per cent, a value closely approximating that of sand casting practice.

Table V

Limits of Composition

Total carbon	Not more than 3.5
Combined carbon	Between 0.45 and 0.80
Silicon	Between 1.8 and 3.0
Manganese	Between 0.4 and 1.2
Sulphur	Not more than 0.12
Phosphorus	Not more than 1.00

Development of the application of the centrifugal process to the production of castings in steel has not been so extensive as in cast iron. There are various reasons for this, of which probably the most dominant is the difficulty of maintaining a continuous supply of molten steel to enable continuous operation of the plant. This, of course, can be and is overcome, but not with the same ease as with cast iron.

Table VI

Typical Analysis

	Per cent
Total carbon	3.45
Graphite	2.85
Combined carbon	0.60
Silicon	2.55
Manganese	0.85
Sulphur	0.09
Phosphorus	0.75

The effect of centrifugally casting steel on the structural characteristics and physical properties of the steel have been ably dealt with in the bureau of standards report No. 192/1921.

At present the only application of the centrifugal process of any magnitude to the production of steel castings in England is the Davis steel wheel process operating at John Brown & Co.'s works at Sheffield. This process is well known in America and its principal object is to secure a manganese steel tread on the wheel. This is done in an ingenious manner by the introduction of powdered ferro-

Table IV

Mechanical Tests on Pipes

Centrifugal Cast Pipes

Diameter of pipe inches	Internal Pressure Test: Bursting pressure pounds	Internal Pressure Test: Calculated tensile tons per sq. in.	Transverse Breaking Test: External pressure pounds	Transverse Breaking Test: Breaking load pounds	Transverse Breaking Test: Deflection at center inches	Transverse Breaking Test: Modulus of rupture pounds
			Modulus of Rupture			
6	2,800	12.75	54,767	31,400	1.13	45,600
8	2,500	13.30	53,595	50,400	0.80	41,000
10	2,250	13.58	55,257	77,300	0.82	41,400
12	2,000	13.46	52,081	103,000	0.64	34,050
			Sand Cast Pipes			
6	2,050	6.94	.....	21,000	0.97	27,200
8	2,200	8.87	.....	33,600	0.62	21,600
10	2,050	9.58	.....	76,100	0.64	26,600
12	1,550	8.04	.....	100,800	0.55	25,600

Note 1—Sand cast pipes approximately 20 per cent thicker than centrifugal pipes. True comparison is brought out by comparing the tensiles and the moduli of rupture rather than actual breaking loads.

Note 2—Transverse tests performed on pipes 12 feet long at 10 feet centers. Load applied at two points 4 feet apart at equal distances from end supports.

*Fox and Wilson, Stanton-Lavaud, Foundry Trade Journal, Jan. 21, 1926.

Table VII

Tensile Tests on Centrifugal Castings

(Hurst-Ball Process)

No.	Tot. C per cent	Si per cent	Mn per cent	S per cent	P per cent	Ultimate strength tons per sq. in.	Remarks
1	3.21	2.75	0.31	0.11	0.64	17.46	Direct Cupola Melted.
2	2.99	2.70	0.39	0.09	0.64	19.40	Metal from Receiver.
3	2.95	2.85	0.28	0.10	0.92	19.95	Metal from Receiver.
4	2.99	1.98	0.35	.....	.....	19.50	Determined on Ring.
5	3.10	2.55	0.29	.....	.....	19.31	Determined on Ring.
6	3.15	2.75	0.29	.....	.....	18.71	Determined on Ring.

manganese into the first portions of liquid metal which enter the rotating mold. By virtue of the rotation this high manganese portion of the steel is located finally in the tread of the wheel. The application of the centrifugal process to the casting of steel pipes, hollow ingots and annular billets for various p rposes is undoubtedly engaging the attention of many steel works' engineers and metallurgists. At the time of writing, however, these applications of the process have not developed on any extensive commercial scale.

Small steel hollow cylinders or bushes were produced in this country particularly during the war-time when they were used to a certain extent for airplane engine cylinder liners. The commercial requirements of small cylindrical steel bushes does not lend itself to the same degree of standardization as in the case of cast iron piston rings, a fact which has operated against more extensive development in this direction.

Metal Not So Available

Supplies of molten nonferrous alloys, available at almost any instant, are not organized so easily as cupola melted cast iron. As in steel this is one of the difficulties to be faced in the extensive application of the centrifugal process to nonferrous alloys. Furthermore, the amount of work available of a repetition character and suitable for the application of the centrifugal process is limited.

In spite of this there are several applications of this process of an extremely valuable nature to the nonferrous industry. The difficulty of producing various brass and bronze sleeve castings sound and free from defects is almost proverbial. The sleeve castings referred to are those used for lining paper mill rolls, hydraulic cylinders and rams, pump liners and similar items. These have been produced consistently in England and in America for many years and the ability to produce these castings free from pinholes and similar defects is an outstanding advantage of the centrifugal process.

Some work also is being done in this country in the application of the process to the production of phosphor bronze worm wheel blanks.

Generally speaking, with the exception of gear wheel blanks, sand molds have been adopted consistently in the production of cylinders by this process. One of the reasons for this is the lack of repeat requirements. In spite of this the advantages of the centrifugal castings process in the production of sound castings free from defects, which after all is the first and foremost requirement of any casting, is amply demonstrated.

Concrete and Other Materials

While the interest of foundrymen is confined largely to the application of the centrifugal process for the production of castings in metals and alloys, its application in other directions should not be overlooked. Extensive developments have taken place in Great Britain and Europe in the production of concrete and reinforced concrete pipes by this process. There are various systems in operation in Great Britain of which probably the largest is the Stanton-Hume system. Among the other systems are the Cochrane-Vianini system of Italian origin and Moir-Buchanan system.

The centrifugal process also is extensively used for lining cast iron and steel pipes with concrete and also with hydrocarbon materials, the basis of which are essentially materials of the nature of pitch and bitumen.

In spite of the fact that we can trace the centrifugal process of casting metals back for at least 120 years, its development on a commercial basis is confined largely to the last decade. The widespread interest which it has created in foundry and engineering circles and the undoubted superiority of its product over the ordinary sand cast material cannot be denied. These facts taken in conjunction with the fact that its principal field of operation is pipe casting, an industry of a gigantic nature, claim attention for the centrifugal process as one of the greatest developments in metallurgical circles during the postwar period. The centrifugal process is essentially a permanent mold process with one or two exceptions in which the process has been developed on the basis of sand molds

Nonferrous Shows Gain

Nonferrous alloys and specific products of nonferrous metals, excepting aluminum, gold and silver, showed an increase in the 1925 biennial census over 1923, according to data compiled by the census of manufacturers, department of commerce. The number of establishments decreased from 1147 in 1923 to 1140 in 1925; of the latter number, 193 were located in New York, 118 in Pennsylvania, 116 in Illinois and the same in Ohio, 85 in Massachusetts, 81 in Michigan, 64 in Connecticut, 63 in New Jersey, 62 in California, and less than 50 each in 30 other states.

The value of products increased 3.7 per cent from $572,251,448 in 1923 to $593,555,540 in 1925. The largest single classification was plates and sheets, valued at $124,473,260. Rods and bars were valued at $65,073,778, castings at $65,980,031, tubing and seamless pipe at $51,012,701 and wire at $50,945,197. Other forms were produced in smaller quantities.

Table VIII

Comparative Wear Resistance Tests

SAND CAST METAL

		Loss
Original weight of specimen	6.7500	
Weight after 3,000,000 revolutions	6.7349	0.0151
Weight after 4,000,000 revolutions	6.7339	0.0010
Weight after 5,000,000 revolutions	6.7335	0.0004
Weight after 7,000,000 revolutions	6.7331	0.0004
Total loss		0.0169

CENTRIFUGALLY CAST METAL

	Grams	Grams
Original weight of specimen	6.7530	
Weight after 3,000,000 revolutions	6.7445	0.0075
Weight after 4,000,000 revolutions	6.7425	0.0030
Weight after 5,000,000 revolutions	6.7325	0.0100
Weight after 7,000,000 revolutions	6.7220	0.0105
Total loss		0.0310

Numbering Patterns Simply SAVES TIME

By F. J. Cook

AN ESSENTIAL part of the work of framing a system for pattern storage consists of developing a method of numbering patterns. Many complicated systems now are in use, which evidently were designed by someone who knew little about the subject.

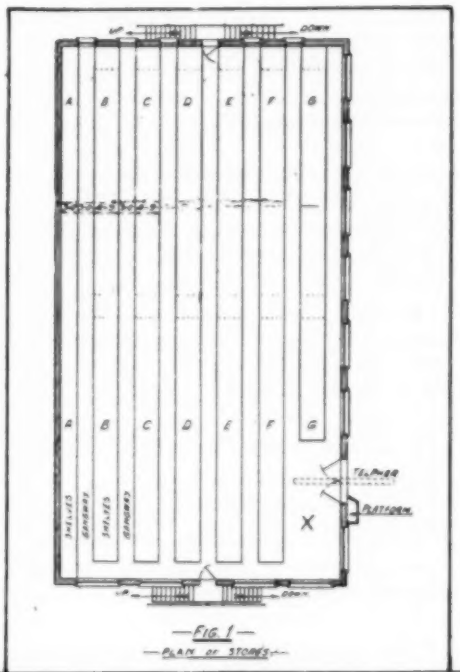
In the system to be described, which is located at Messrs. Bellis & Morcony Ltd., Birmingham, England, it was necessary to number the patterns with the smallest possible number of figures which would be effective, and to store the patterns in such a way that they could be located, not only by one man, as is usually the case, but by anyone connected with the pattern department. Approximately 1000 new patterns are added to the number in storage every 5 months. The number of new patterns added to the storage continued for a number of years, but recently the number added has been reduced considerably.

Each pattern made, irrespective of its size, standard, or type of machine, is given the next number in numerical order. To keep down the number of figures required, no number is allowed to go over 1000. To distinguish the pattern each 1000 numbers has a prefix of a letter of the alphabet until the entire alphabet is used. Each letter of the alphabet then is used as an affix. When the whole alphabet is used two times, once as a prefix and once as an affix, the system may be continued by using the letter first above and then under the number. The entire system will accommodate the numbering of 105,000 patterns, which is a quantity above that usually required by the ordinary foundry pattern storage. Although the system has been in use for 28 years in a foundry generally employing over 70 patternmakers, the pattern numbering has not nearly exhausted the provision of using the alphabet as a prefix and affix. With a production of 1000 new patturns every 5 months, the system is estimated to last at least for 50 years.

This system of numbering has many advantages. In the first place only one pattern in a thousand has five figures or letters, 10 have two, 90 have three, and the remaining 900 only four figures and letters. This results in a reasonable saving in the cost of figures and letters and the fixing of same on the pattern. A small number of figures also results in a saving in the time required to make out orders and in various departments which keep records of patterns or castings.

Pattern numbers, when given out to the patternmaker, are entered into a pattern register along with all the necessary information regarding them. The register is divided into spaces of the following widths and titles, as is shown in Fig. 4.

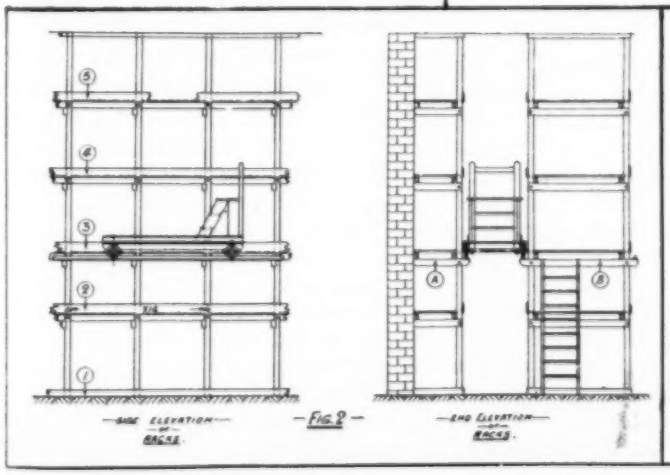
The first division is 1-inch wide, and is headed *pattern number*. The next, which is 2¾ inches wide, shows the *name of the pattern*. The next two divisions each are ½-inch wide; the first containing the piecework *contract number* under which the pattern was made, and the next the *stores* in which the pattern is to be kept. The next two each are ⅜-inch wide. The first contains the letter indicating the *bin* in the pattern stores, and the other the number of the *shelf* of the bin on which the pattern will be kept. The next space is ¾-inch wide, and contains particulars of the size or *stand-*



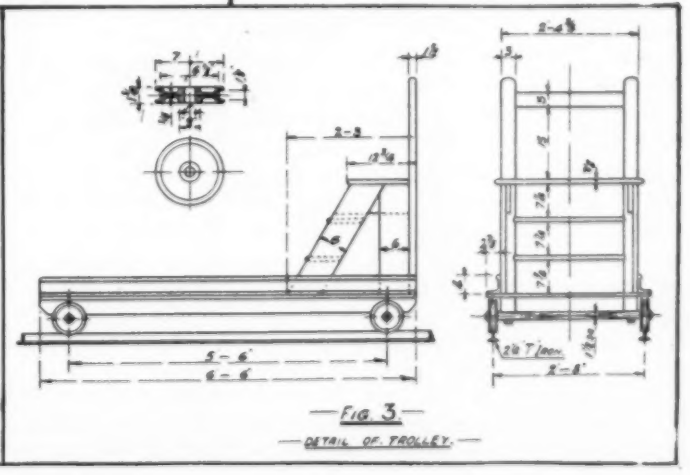
—FIG. 1—
—PLAN OF STORES—

Fig. 1—(Right)—Plan of One of the Storages Showing the General Arrangement of Bins.
Fig. 2 (Below)—Details of Bin Construction

Fig. 3 (Below)—A Specially Constructed Carriage Is Employed To Transport the Patterns to the Proper Bins



—FIG. 2—



—FIG. 3—
—DETAIL OF TROLLEY—

ard of engine for which the pattern is used. The next space is also ¾-inch wide and contains the *engine number* for which the pattern originally was made. The next three spaces each are ¾-inch wide. The first lists the *drawing number* under which the pattern was made; the second the date on which the pattern was *made*, and the third the *date* on which the pattern was *destroyed*.

Patterns Kept in Bins

When a pattern is completed, the distinguishing number, also of the bin and shelf on which it has to be kept when not in use, are assigned. Each of the bins in the pattern storage is divided into sections which are indicated by bench marks in black varnish. Each division is alloted to a particular standard of engine. Both the letter and number indicating the bin and shelf, and also the standard of the engine, is stamped plainly on the pattern, which indicates to the pattern storekeeper exactly where each pattern has to be kept. By referring to the register anyone quickly may learn the position in which the pattern should be found, if it is not in use in the foundry.

It also will be noted that the patterns are made under piece work, or properly a premium bonus plan. The system is built upon the principle of the percentage saved is the percentage paid. Since particulars of all the contract numbers are kept, it is easy to turn to the record and find the number of hours required to produce any given pattern. This information often is useful as a guide when fixing a piecework price or preparing an estimate of patternmaking costs on any particular job.

It also is obvious that more than one pattern storage is required to hold the many thousands of patterns in existence. Several views of one storage are given in Figs. 1, 2 and 3. The storage shown is typical of the various units in which patterns that may be handled by hand, are kept. The large patterns are kept under a traveling crane in a covered yard to facilitate handling outside the shop.

Fig. 1 is a plan of one of the storages, and shows the general arrangement of the storage bins, shelves, and the gangways. This storage occupies the middle floor of a three story building, the patternshop being on the floor above. Each room is, as far as possible, fire proof, automatic sprinklers being fixed in the roof. The concrete floor is about 6 inches below the door sills so that in case of fire the entire floor would be flooded with water to this depth. A telpher, indicated in Fig. 1, may be worked from either floor from the projecting platform shown. Patterns may be delivered to either story. As the patterns arrive from the foundry they are assembled temporarily at *X*, and are sorted carefully.

The entire storage is worked without the aid of a portable ladder by a runway running between each bin as shown in Fig. 2. The details of the carriage are shown in Fig. 3. After sorting, all patterns which must be stored above the second shelf are placed on the platform of the carriage. When the carriage platform is full the store attendant mounts it by a fixed ladder at the end of each bin and propels himself along to the desired position in which the pattern is to be deposited.

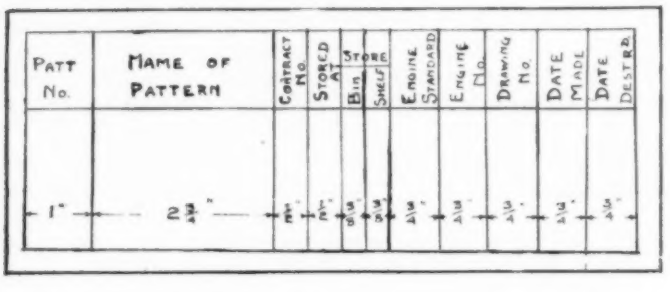


Fig. 1—Pattern Information Is Kept in a Special Register

Gives Bin Details

Detail of the storage bin construction is shown in Fig. 2. The vertical members of the frame are made from 3 x 3-inch lumber, the cross pieces out of 2 x 4-inch stock. The cross pieces are set ½-inch into the uprights. The cross members supporting the second shelf extend beyond the width of the frame to carry the tee iron runway for the carriage. The shelving consists of ¾-inch lumber, 5 to 7 inches wide and open spaced. The sketch shows them placed across the width of the bin but subsequently they were placed lengthwise which eliminated the longitudinal member shown, and thereby effected a further economy in an already cheap method of framing. A vertical piece of wood is placed along each shelf. This defines the limits within which the pattern must be kept to avoid its fouling the runway carriage or walking space. This side member is useful to indicate the number of the shelf and the bench mark divisions for the various standards as indicated. The frames are placed at about 3 feet 9 inches centers. The height of the various shelves will, of course, depend upon the class of patterns to be accommodated. The first shelf shown in the drawing is 3 feet 6 inches above the floor, and the subsequent ones are 2 feet 5 inches, 3 feet 2 inches and 3 feet 2 inches in the clear respectively.

Where larger patterns have to be accommodated, the first shelf has been placed 4 feet above the floor, and subsequent ones at 2 feet, 3 feet and 3 feet in the clear. In the case of the former arrangement of shelves it is necessary to leave out the first shelf between one of the staging frames to provide a passage as indicated by dotted lines in Fig. 1, and also at the end opposite the ladder.

The placing of the ladder at the gangway end ensures that the carriage will be always at its most convenient position when not in use.

Fig. 3 shows details of the carriage. It has been designed to give plenty of temporary storage space and is arranged to prevent tipping. The steps are arranged so that the entire width of the top shelf of the racks may be reached quite easily.

Present Conveyor Data

Engineers, plant operators and others using belt conveyor equipment will find the new 148-page catalog issued by the Link-Belt Co., Chicago, a valuable addition to the available literature on the subject. Complete engineering data on belt conveyors, including formulas, which is claimed not to have been published previously, are contained in this new catalog. Numerous illustrations, diagrams and tables are used to illustrate the text matter and show the various types of belt conveying equipment and accessories. This catalog is known as conveyor data book No. 615 and is a companion publication to the previously published booklets on elevators and chain drives.

Purchases Company

General Refractories Co., Ltd., Sheffield, England, has purchased control of the Worksop Brick Co., Ltd., Worksop, England, and is erecting a modern refractories plant at this point. Frank Russell, who accompanied the British delegation to the American Foundrymen's convention at Detroit in 1926, is chairman of the General Refractories Co.

Bill Decides to Cut Out Long Words

By Pat Dwyer

SEVERAL months ago while looking through an attractive little brochure issued annually by a prominent mid-west newspaper and containing a collection of the best things that had appeared in the *Colyumn* during the year, I found a little poem that made me wonder how it would have appealed to me if I had read it when I was twenty-one. It is too long to quote in its entirety, but the following extract will serve for an illustration:

Boots and saddles! And bold and bright
Youth goes galloping. Youth that jeers
Death and the Dust in pride of might—
War is ever the word it hears;
Peace is ever the pact it fears
When roll the drums of the foe's advance.
Athos, Porthos, the Musketeers
Ride again in the land of France!

* * *

Stirrup-cups for the cavaliers,
And the old oath over of old romance—
"One for all!" and the Musketeers
Ride again in the land of France!

If I had read that once upon a time I imagine it would have caused delightful little shivers to run up and down my back and I would have thrilled to the ends of my fingers and toes. In fancy, I could see myself one of the gallant band in jack boots and plumed slouch hat, rapier brandished high, tearing like a whirlwind through Normandy, Picardy and Lorraine on the magical wings of romance.

Experience of many years in the daily battle to keep one hop ahead of the sheriff, the devil and the old clothes man, I regret to say, effectually has knocked any romantic notions I may have had, out of my system. I read the poem and said to myself, "A fat lot the poor prune knows about France."

Give me a pair of carpet slippers, a pipe and a book, regular meals, a comfortable place to sleep and a steady job—one in which the hours are not too long and the work is not too hard—and any person who wants it can have my share of belting around France or any other country, half fed, half clothed and mounted on a ringtailed, spavined, old candidate for a glue factory. Romance! Bah! twice.

A few weeks ago I discovered that romance, although perhaps in a different setting, appeals as strongly to modern youth as it did in the days of the Musketeers, or in still more recent years when the flower of our young manhood followed the streaming folds of Old Glory across the wide salt sea to where row on row, the blood red poppies bloomed on Flanders fields.

Following their graduation one of my sons, one of Bill's boys and a third hardy adventurer decided to tour part of these United States before offering their valuable services to eager employers. In former vacation periods they had explored the South and the East. This year with more time at their disposal they decided to follow the footsteps of the fur traders, the forty niners and the conquistadors who had pushed westward into Washington, Oregon, upper and lower California when pushing was a real man's job.

THE SCHOLAR PICKS OUT A FEW LONG ONES

They had no intention of emulating these hardy pioneers either on foot or on horseback. Railroad trains, either passenger or freight were ruled out of the program. The first because they did not have the fare. The second because the stop over privileges were limited, the schedules were irregular, the train crews were notoriously discourteous; and they had no desire to test the hospitality of jails along the way.

Pooling the slender financial resources they rescued an old automobile and then spent a feverish two weeks in taking it apart, reassembling and reconditioning it for the long grind.

Is it not St. Paul who said "Faith without good works is dead" or of no avail, or something to that general effect? Apparently the boys had both the faith and the works. According to the latest bulletin they were nearing the border into Old Mexico and still going strong. They had finished two legs of their proposed triangular course, up through the Pacific northwest, south through Washington, Oregon and California and now were contemplating a zig-zag northeast course that eventually will bring them home.

Before they started I ventured to inquire of my son how he expected to exist for a period of three or four months. Adventure and romance might satisfy the

yearnings of the spirit, but unfortunately the mortal frame requires something more substantial. To the best of my knowledge, conditions in the West parallel closely those in the East. Manna no longer appears miraculously every morning in the desert. Dealers in provisions and gasoline show a disconcerting disposition to finger the long green before they hand over one or the other.

"That's a funny question for you to ask" he said. "I am only going away for a few months. You spent several years—back in the dark ages, it is true—rambling this country on your own and apparently you survived. I never heard you complain that you had to go hungry. In fact" and here he favored me with a friendly, impudent grin "looking at you now I should say you never missed a meal since you were born."

"My dear boy" I said "keep your feet on the ground and keep your irreverent remarks to yourself. When I was your age I had a figure—"

"Yes I know" he grinned. "I have seen your picture. You bore a striking resemblance to the figure 1."

"One more peep out of you my lad" I reminded him in my best parental manner, promptly discounted 97 per cent "and you will look like an anaemic interrogation point. Figures or no figures, before you are a month on the road you will require all your figures to figure a way of keeping body and soul together. Figures have their place in the eternal scheme of things, but a bunch of figures is a poor substitute for a plate of ham an'.

"Anyway" I continued "your proposed journey and mine long past bear little resemblance to each other. I was a duly qualified young journeyman molder, able to get a job in every town I struck and, what is more important, competent to hold it as long as I felt like remaining in that place. I made good money, according to the standards prevailing in those days. I paid my own way, owed no man anything, looked the world in the face and consequently in the immortal words of the late Mr. Longfellow, was in a position any time to tell it to take a long running jump in the lake."

"My ambition too" says the young hopeful.

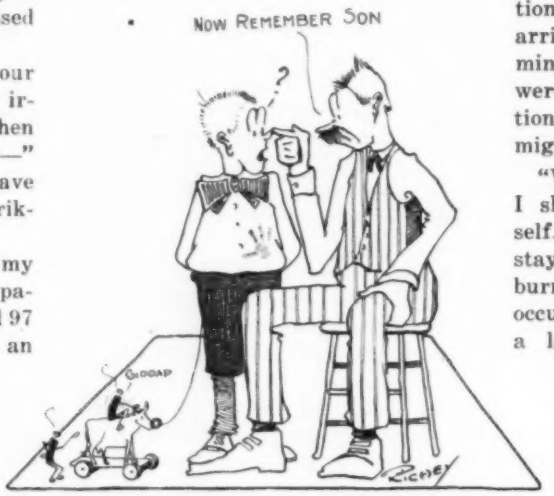
"What do you mean your ambition?" I inquired.

"That last part of your spiel" he said. "Tell 'em all to take a long running jump in the lake!"

"Listen" I said. "You are too ambitious. Also you fail to get the point of this fatherly discourse. Before you start out giving any long distance jumping invitations, you must have the goods to back up the request."

"That's all right," he assured me. "We'll have the goods. We intend to linger a few days here and there as we go along. Lend a hand as the saying is, honest labor, brow is wet with honest sweat and all that kind of thing. In return for this well meant effort we expect to be rewarded generously. The laborer is worthy of his hire and so forth. We expect to pick up enough change to—er—ah—adequately defray all expenses."

"Ah! youth, youth!" I remarked, wagging an imaginary brush to and fro. "With your training and experience what kind of work do you expect to find waiting in the great open spaces?"



FATHER AND SON BANDY A FEW WORDS

"Why," he remarked confidently, "We'll work at anything."

"Anything?"

"Well," he qualified, "Almost anything. We'll not go near a foundry. I had a month of that last summer and I am off it for life."

Occasionally bulletins have come floating back detailing some of the incidents along the line of march. The lads floated into Belle Fourche, South Dakota in time to see the annual rodeo and incidentally to get a full and unobstructed view of our most distinguished citizen masquerading for the day in a pair of chaps and a 10-gallon hat.

Example is contagious. They spent all their funds in decking themselves out in similar regalia and then worked for a week juggling bags of cement and machinery in a new beet sugar factory. Rolling in wealth they piled into the old machine and spent the following week rambling around Yellowstone park, pushing lazy bears and other wild animals off the trail.

On another occasion in a spirit of bravado they spread their blankets in a cemetery, a nice quiet place and curled up for the night. In the morning they got the fright of their young lives when they discovered a sign warning tourists to beware, the place was infested with rattle snakes!

D'Artagnan and the Musketeers riding again in the land of France! Pikers! They never rode in chaps and 10-gallon hats and slept with a family of rattlesnakes!

Bill came over the other night to inquire if we had any recent word from the wanderers. He had heard nothing for over a week and the Missus was worrying over the situation. I showed him a letter which had arrived that day and which set his mind at rest. Apparently, the lads were enjoying life and had no conception that their prolonged absence might be the cause of any anxiety.

"Well," said Bill, "It's a great life. I should like to make the tour myself. However, some person has to stay home and keep the home fires burning. Sometimes even that prosaic occupation has its high spots. I had a letter today from an old friend which kept me scouting through a dictionary for an hour for the meaning of some of the words. When Jim gets going good he can run rings around our old friend Webster. Listen."

Dear Bill:

Familiar as I am with your exemplary career in the foundry industry, from the day you started to claywash gaggers for a husky hobo molder, to the time you successfully operated a foundry on the Punch and Judy system, that is by pulling all the necessary strings from the office desk while you sat comfortably enjoying your pipe and your memorandums, I want to ask you as a particularly observant pilgrim if you ever in your vigorous and variegated foundry career encountered one of these mysterious curiosities, objects or what have you, known as a *Dentrite?*

"What do you think of that?" said Bill, "all in one breath too mind you."

"Some breath," I admitted. "That lad would make a great deep sea diver. What did he say when he came up for air the second time?"

"Plenty," said Bill. "Plenty, my boy. Pay attention."

Covering a life span of 50 years perhaps I have had more than my share of troubles with both my first and second set of grinders. Consequently I may claim a fair degree of familiarity with things of a *dentigerous* nature. However, I fail

to find any trace, hair, hide or toenails, of this word in any of the ponderous tomes through which I browsed for definitions of unfamiliar expressions. I laid bare the Latin and Greek roots of our mother tongue and followed the tap roots and tentacles down into the Arabic and Babylonian strata and there I was stuck. Hence this polite interrogation.

"How's that for tall English?" Bill inquired.

"Tall is not the word," I corrected him. "That is deep stuff."

"Whether it is tall or deep," Bill admitted, 'It is over my head. See what you can make of the rest of it. Two of these words dentilitic and dentriodal sound as if they might have been resurrected from that place where the boy friend once was a king in Babylon and the kid was a Christian slave."

Has the word any connection with things dentalitic or dentriodal as opposed to things metallic or metallurgical? Does it refer to molars, bicuspids, eye teeth or wisdom teeth? Is it a tooth filling, a dentrifice or that mysterious something with which four out of five of us are afflicted without our knowledge or consent and which gives our friends and neighbors a chance to titter behind our backs? On the other hand, is the word hooked up in any way with gear teeth, spur, bevel, helical, worm, herringbone or what have you up your sleeve? By any chance is the reference intended for laws credited upon their enactment with the possession of teeth that nip the unwary evader?

"He is coming down to my level now," said Bill, "when he starts talking about gear wheels."

"Something into which you can get your teeth, eh?" I remarked.

"The next paragraph has a familiar foundry slant also," said Bill. "At least the first part is familiar. Many a time have I seen an apparently good casting scrapped after the removal of a big riser disclosed a cavity in which according to the accepted foundry saying, 'You could bury a dog.' When I was a young fellow I often wondered why a dog had been selected for a comparison. Have you any theories on the subject?"

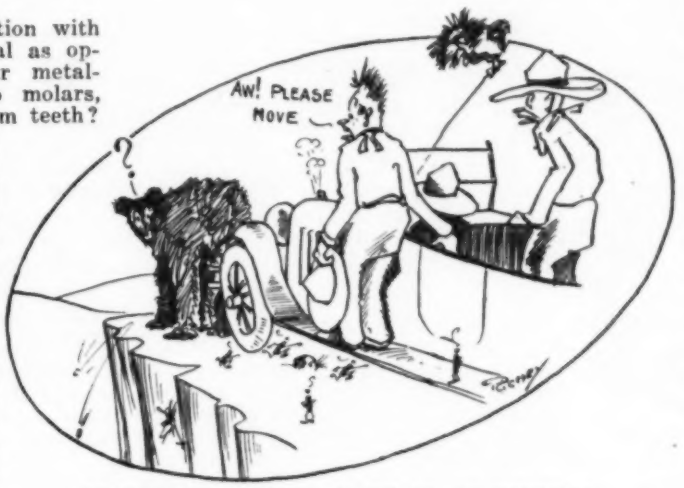
"If I was pushed into a corner," I said, "I might hazard a guess, but this is no discussion on dogs and their families. Go ahead. Read the remainder of the document."

Have you ever looked into a repulsive cavity where a casting has bled to death and observed the little stalagmites and stalactites that festoon the interior? By any stretch of the imagination could these be described as *dentrites?*

Bill dear, please put down your pipe, take up your trusty old pen or your little stubby pencil. Bring into play your most vivid imagination and draw for me a sketch of a dentrite or anything dentritic that will assist me in bringing my wearied vocabulary up to date. Us scientific guys have a reputation to sustain. When my less fortunate brethren appeal for information on deep scientific subjects I want to be in a position to explain the difference between a square hole, a round hole, a shrink hole, a hole due to bleeding or a common blow hole. Will you do this for your old side kick

Jas. A. Murphy

P. S. Striking a snag like this in my limited reading and endeavoring to run the meaning to earth causes my mind to revert to the classic answer of the boy whose dog bit his father—the boy's father. "Never mind a little pinch like that Paw" he said "It might be the makin's of the pup!"



PEDESTRIAN RESENTS ATTITUDE OF TOURISTS

"There y'are," said Bill, refolding the letter and placing it in his pocket. "What do you think of that for a noble effort?"

"The question," I said, "is not what do I think about it, but what are you going to do about it?"

"Who? Me?" Bill returned in astonishment. "Nothing my lad. Long ago I learned that the easiest way to answer a difficult letter is not to answer it. The method saves a lot of valuable time and brain fag and the net result is about the same. Jim is one of the cleverest foundrymen I know and does not need advice from me or any other person.

"I don't know what started him off on this dentrite investigation, but probably it is the natural reaction of many practical foundrymen when they read or hear a discussion on some common foundry phenomenon couched in language and bristling with terms entirely over their heads. According to my limited lights I always have believed that words are a medium for conveying our thoughts. I have read Tallyrand's famous epigram 'Men use words to conceal their thoughts', but he was thinking of diplomats whose minds work on the corkscrew principle, take everything and give nothing.

"The great majority of foundrymen are plain ordinary citizens with a vocabulary sufficient for their needs and there is no good reason why oral or written discussions of foundry subjects can not be presented in words within their comprehension. Rare and far fetched terms may reflect a man's erudition to a certain extent, but they defeat the primary object of any practical discussion, in that they convey no meaning or instruction to the hearers or readers. I am in favor of starting a movement for less and shorter words in all foundry discussions.

"Probably you are strongly tempted to spring that old moss grown 'Yeah! You and who else?' Well if it comes right down to brass tacks, a show down and all that kind of thing, I shall not be surprised to find that I can gather up a considerable number of hardy lads ready and willing to give me aid and support in such a worthy venture."

"Count me in my dear Aramis," I said. "Rapiers! Rapiers! Musketeers ride again in the land of France—and *a bas* the long brain-racking, tongue-twisting words!"

Sand Collects Slag

Question—Why do some foundrymen throw sand on ladles of iron and then skim it off?

Answer—Sand is thrown on the ladle to collect small particles of slag and other dirt which can then be skimmed off more easily. If the ladle is not skimmed the sand will be of little benefit. Some foundries use a skimming spout on their ladles. The spout holds back the slag, leaving the iron run off from the lower part of the ladle instead of from the top.

The Merrick Foundry Co., Waterbury, Conn., brass, bronze and aluminum castings, a subsidiary of the Waterbury company, will move into new quarters in the plant formerly occupied by the Eastern Brass & Ingot Co. The latter company went out of business some years ago and the plant has been idle since.

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Refines Cast Iron

Refining and Desulphurization of Cast Iron, by E. Hamelius, *La Revue de Fonderie Moderne*, Paris April 10, 1927.

To obtain cast iron with a fine and homogeneous grain, one must eliminate impurities, especially sulphur. The present method is based on the fact that impurities with a low specific weight eliminate themselves in liquid iron. It should be sufficient to let the molten iron remain still for the requisite time, but the solidification of iron and of slag stops the process. It is recommended to use a fore-hearth heated by the cupola gases, where the iron collects and remains in a molten state, the slag being collected from the cupola in a separate container. To desulphurize the iron, briquettes of soda and borax, are introduced into the iron in the fore-hearth. The way in which a cupola can be modified to satisfy the requisite conditions is described, and it is claimed that the cost of installation is quickly covered by the ultimate saving, besides giving purer iron.

Determines Manganese-Sulphur Ratio

The Influence of Manganese and Manganese Sulphide on Whiteheart Malleable, by E. R. Taylor, *Foundry Trade Journal*, July 7 and 14, 1927.

This article was presented at the Sheffield convention of the Institute of British Foundrymen held in July. Tests performed by the author led him to draw the following conclusions:

In whiteheart malleable the best mechanical results are obtained when the manganese-sulphur ratio is not greater than 1:2. When the ratio is much less than this, good bend tests can be obtained, but the elongation appears to suffer. Metal containing excess manganese is strong without being ductile and anneals to finely divided pearlite instead of ferrite.

Sulphur in the absence of manganese is deleterious to the mechanical properties of whiteheart malleable. Manganese in the absence of sulphur is deleterious to the ductility of whiteheart malleable.

Manganese and sulphur together neutralize the harmful properties of both by the formation of sulphide. The manganese may be present in the proportion of 1 to 2 parts manganese to 1 of sulphur, to offset the disadvantage of sulphur without incurring the disadvantage of undue excess manganese.

There seems to be no reason why medium and high sulphur irons, otherwise suitable, should not be employed for whiteheart malleable, provided the iron carries the quota of manganese not exceeding that mentioned previously, as the sulphide formed does not appear seriously to affect the mechanical properties. The lowest sulphur pig available of course is to be preferred.

Whiteheart malleable bars appear to lose sulphur during annealing when manganese is absent, and gain it when manganese is present, that is, sulphur change during annealing appears to depend upon the character of the sulphide formed.

Gives Rapid Method

A Rapid Method of Analysing Cast Iron, by Michel Cymboliste, *La Revue de Fonderie Moderne*, Paris, April 25, 1927.

The analyses of silicon, phosphorus and manganese are conducted simultaneously with the use of one sample of 1 gram of turnings. The sample is treated by a sulphonitric solution which precipitates the graphite and silica. The liquor is filtered and the silica is weighed after calcination of the filter. A portion of the filtered liquor is used to calculate the percentage of phosphorus by oxidation and precipitation of phosphomolybdate of ammonia. Another portion of the original liquor is used for determing the manganese by a method which is described.

Carbon is analyzed by direct combustion of the metal in oxygen and by the measuring of the volume of carbon dioxide; this operation requires ten minutes. The sulphur is analyzed by the Francke method. The article tells how the various operations can be conducted in the minimum of time.

May Develop New Process

On the Effect of Nickel and Chromium on the Strength Properties of Gray Cast Iron, by Prof. E. Piwowarsky, *Foundry Trade Journal*, July 7 and 14, 1927.

This article on gray cast iron was presented at the Sheffield convention of the Institute of British Foundrymen held in July and gives some of the results obtained by the author upon the effect of nickel and chromium additions to cast iron, cast in sand molds and in chill molds. The specimens then were subjected to various heat treatments, and tested for transverse and tensile strengths; brinell hardness; machining qualities, and examined for structural formation.

The cast iron was composed of German hematite pig and dead mild steel and made into two series, one containing high carbon and low silicon and the other containing low carbon and high silicon. The iron was melted in a magnesite lined graphite crucible in an oil-fired furnace. The temperature was raised to about 1550 degrees Cent. when the crucible was removed from the furnace and the heat was poured at 1400 degrees. The author's summary follows:

By causing a cast iron having a gray to mottled initial structure to solidify at first white to mottled by accelerated cooling, and graphitizing it only by a subsequent annealing, mechanical strengths of a range hitherto unreached, were obtained. In high grade material of this kind with an original bending strength from 114,000 to 143,000 pounds per square inch, an increase to 140,500 to 183,000 pounds per square inch was effected by the addition of nickel or of nickel-chromium. The deflection of such material in the bending test is two to three times that of ordinary pearlitic gray cast iron. Tensile tests in which the elimination of large defects was insured, showed measurable elongations from 2 to 4 per cent with values up to 106,500 pounds per square inch. Notwithstanding the high hardness figures (200-300 brinell) the machinability of all samples was at least as good as that of ordinary good gray cast iron. If suitably turned to account, these tests should result in a quick annealing process giving unusually high strength values with the shortest possible heating period.

Presents Malleable Data

Malleable Iron, by M. Leroyer, *La Revue de Fonderie Moderne*, Paris, May 10, 1927.

The author begins with an historical sketch of malleable iron, following its developments in Europe and in America, and showing the progress made in the physical characteristics in 1915, 1919 and today. He then gives a definition of the various constituents to be found in malleable iron, showing that the iron will be all the more malleable after reheating and that it contains more ferrite.

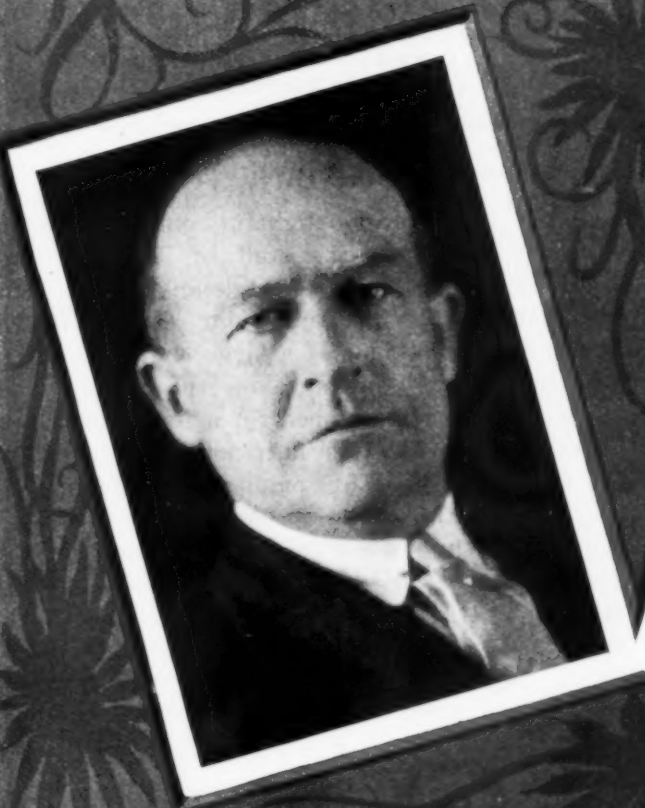
Dealing first with American black heart malleable, the author gives a theory of graphitization, based on the iron-carbon diagram established by Anson Hayes, Diederichs, and Flanders of the Iowa state college. The influence of the various elements on graphitization is given. It is stated that black heart malleable is the only iron product the elongation of which increases with the tensile strength, this result being arrived at by a decrease of the carbon contents. Schwartz and Guiler's investigations on the influence of rare elements are quoted. Two chapters are devoted to the influence of temperature and time, and the influence of carbon dioxide and carbon monoxide on graphitization.

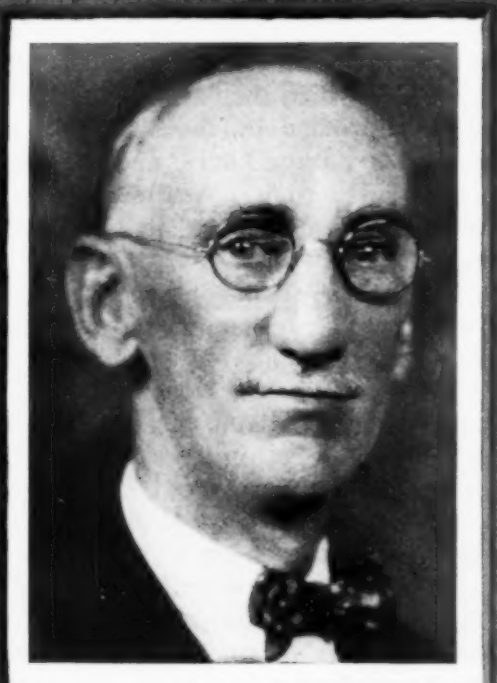
Aluminum Affects Soundness

Phenomena Met With in Unsound Bronzes, by E. Decherf, *La Revue de Fonderie Moderne*, March, 25, 1927.

A short article with two micrographs showing the effects of aluminum contained in the scrap used in making bronze castings.

The FOUNDRY Family Photograph Album





Upper Left

P. M. LEACH, Glenwood Range Co., Taunton, Mass.

Lower Left

B. D. FULLER, Whitehead Bros. Co., Cleveland

Upper Right

W. A. HERRON, Lewis Foundry & Machine Co., Pittsburgh

Lower Right

PAT DWYER, Engineering Editor, THE FOUNDRY

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ Only Three Generations

"THREE generations from shirt sleeves to shirt sleeves," was the witty phrase employed many years ago by some clever writer or speaker to indicate the manner in which the wheel of fortune turns in America. The shirt-sleeved father amasses a fortune in the sweat of his brow. The son has no occasion to remove his coat. No great amount of physical or even mental energy is required to spend money foolishly. Witness the proverb about the drunken sailor. The grandson finds himself practically where his grandfather started, at the bottom of the ladder and in his shirt sleeves. The foregoing is not an invariable rule. Many examples might be quoted of families in which the money made by the father was doubled by the son or in some instances the son-in-law and pushed to a really handsome figure by the grandson. However, these instances are exceptional.

IN THE foundry business the son does not need even to spend the money recklessly or in any other manner. All he has to do is to pay little or no attention to his business and his money will disappear so fast that he stands a good chance of beating his son to the shirt sleeve stage. A big, idle foundry or a foundry in which the owner delegates the management to an incompetent person can lose money faster than anything else of its size in the industrial field.

A GREAT deal of care and effort, hard work mental and physical, intense application and long hours are necessary to establish a foundry on a solid, paying base. By the time the son enters the business, standards have been established, steady customers have been secured. Skillful supervision and careful planning has resulted in a machine that apparently runs automatically at high speed. So long as the wheel is in competent hands of either father or son the machine will maintain the pace. With the father gone and with the son's mind on anything but the road ahead, a wreck is inevitable in a short time.

¶ Too Busy To Read

ONE of the most delightful compensations for being an editor on the staff of THE FOUNDRY, is an occasional visit or friendly letter, from an old time subscriber or regular reader. Recently, the superintendent of a large shop in southern Pennsylvania, who has taken the paper almost since its inception, stopped for a few hours, in the course of his vacation automobile tour, to pass the time of day. This man, although busy with the many duties of an important executive position, finds time when he receives each issue of THE FOUNDRY, to read it through, from the first page to the last. "I read everything, including the ads," said this gentleman, "and in the advertizing pages, as well as the editorial articles, I have found many things that have helped me."

THIS represents the average viewpoint of readers of THE FOUNDRY, but exceptions occasionally are encountered. Some few are found from time to time, who affirm that they are *too busy* to read the business or technical papers that cover the line of work in which they are employed. This plea seldom is supported by facts. Follow such a man through his waking hours, and the phrase, *too busy*, hardly seems to fit. At times, he may be rushing about, apparently oppressed by his manifold duties. The next half hour may find him discussing the merits of the local ball team or swapping golf lies, or automobile exaggerations with someone who is equally *too busy*.

In the evening, this same *busy* individual absorbs a hasty meal so that he may rush forth to the nearest movie, the bathing beach, amusement park, or propel the family car out into the ever-growing tangle of automotive traffic. Of course, he may spend a quiet evening at home where a few hands of cards or persistently twisting the dials on the family radio keeps him busy.

Meantime, this man's associates, who are not *too busy* to keep abreast of the times, through careful reading of the publications devoted to their field, find time to pass along to the jobs that are higher up in the scale of accomplishment.

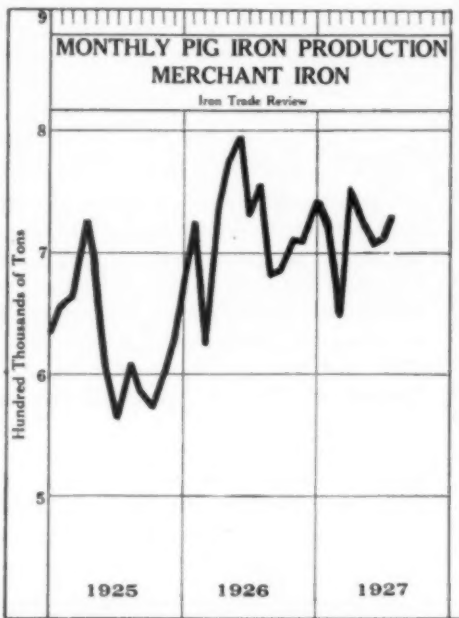
Trade Trends in Tabloid

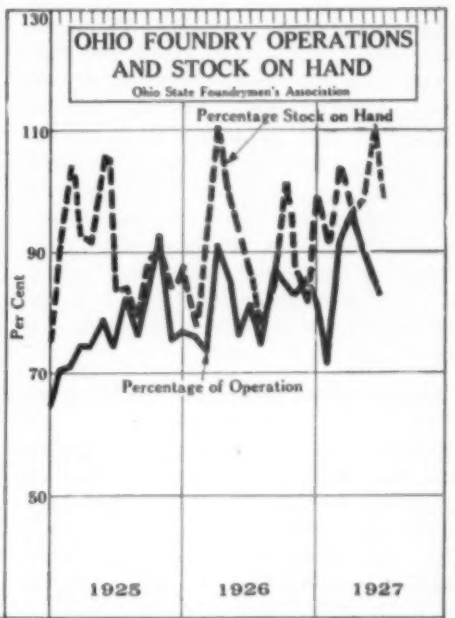
INDICATIONS point to the end of the midsummer slackness in foundry operations. Inquiries for general jobbing castings in the eastern and midwestern sections are increasing. Brightening outlook for the farm interests of the country are strengthening purchases of all classes of commodities. Employment figures show a slow pickup in manufacturing activity. Purchases of pig iron and other foundry materials are improving. While steel production has suffered a setback, orders are increasing and point to satisfactory fall business. Railway car purchases still remain at low ebb and car loadings are slightly behind 1926. Building construction is spotty, with increases only in the western states. Automobile output has declined during the summer, but increased activity is expected in the early fall. Pig iron and scrap prices have declined. The total output of pig iron for July, according to *Iron Trade Review* statistics was 2,944,251 tons, compared with 3,089,726 tons for June and 3,224,663 tons for July last year. The production of merchant iron increased from 714,268 tons in June to 726,565 tons in July. Average New York prices for nonferrous metals during July, according to *Daily Metal Trade* as follow: Casting copper, 12.608c; electrolytic copper, 12.774c; Straits tin, 64.048c; lead, 6.357c; antimony, 11.865c, aluminum, 25.375c. Zinc average 6.235c, E. St. Louis.

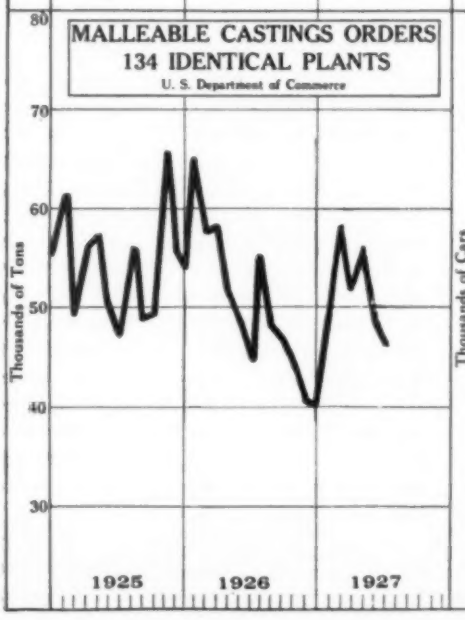
RAW MATERIAL PRICES

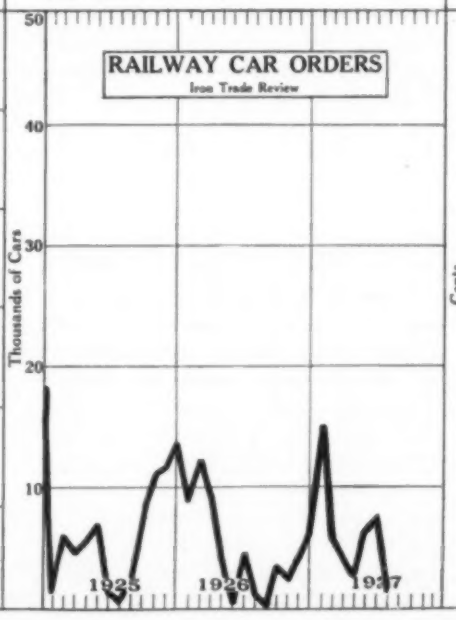
August 6, 1927

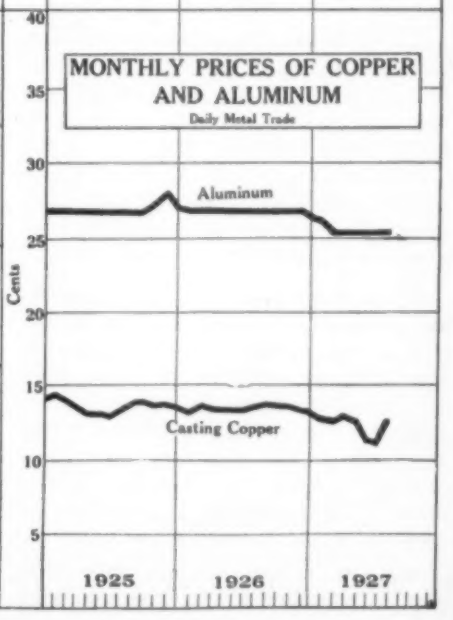
No. 2 foundry, Valley	$17.50 to 18.00
No. 2 southern, Birmingham	17.25
No. 2 foundry, Chicago	20.00
No. 2 foundry, Philadelphia	21.26
No. 2 foundry, Buffalo	17.00 to 17.50
Basic, Valley	17.50
Basic, Buffalo	17.00 to 17.25
Malleable, Chicago	19.50
Malleable, Buffalo	17.00 to 17.50
Coke	
Connellsville foundry coke	$4.00 to 4.75
Wise county foundry coke	4.00 to 5.00
Scrap	
Heavy melting steel, Valley	$15.50 to 16.00
Heavy melting steel, Pitts.	15.50 to 16.00
Heavy melting steel, Chicago	12.75 to 13.00
Stove plate, Chicago	12.25 to 12.75
No. 1 cast, New York	13.00 to 13.25
No. 1 cast, Chicago	15.00 to 15.50
No. 1 cast, Philadelphia	16.00 to 16.50
No. 1 cast, Pittsburgh	15.00 to 15.50
No. 1 cast, Birmingham	14.00 to 15.00
No. 1 cast, Buffalo	15.00 to 15.50
Car wheels, iron, Pittsburgh	15.00 to 15.50
Car wheels, iron, Chicago	14.75 to 15.50
Railroad malleable, Chicago	14.50 to 15.00
Agricultural Mal., Chicago	13.00 to 13.50
Malleable, Buffalo	15.00 to 15.50
Railroad malleable, Pitts.	14.50 to 15.00
Nonferrous Metals	Cents per pound
Casting copper, refinery	13.12½
Electro copper, producers	13.37½
Straits tin	65.62½
Lead, New York	6.75
Antimony, New York	12.12½
Nickel, electro	39.00
Aluminum, No. 12, producers	24.50
Aluminum, No. 12, remelt	18.50 to 19.50
Zinc, East St. Louis, Ill.	6.40











Comings and Goings of Foundrymen

HYMAN BORNSTEIN, recently elected president of the Quad City Foundrymen's association is widely known throughout the foundry and metallurgical world. He was born in Chicago, Sept. 3, 1891 and attended the public schools. He was graduated from Armour Institute of Technology in 1911 with the degree of B. S. in chemical engineering. Later he studied under the John Marshall law school from which he received a degree in 1915. During the time that he was studying law, Mr. Bornstein was employed as chemist for the Union Pacific railway, Swift & Co. and the city of Chicago successively. Mr. Bornstein entered the army in 1917 and became captain in the ordnance department. Following the close of the war he was made chief chemist and metallurgist for Deere & Co., Moline, Ill., a position which he still occupies. He holds active membership in the American Chemical society, American Institute of Mining and Metallurgical Engineers, American Society for Steel Treating and the American Society for Testing Materials. He is a director of the steel treating organization.

Sherwood C. Bliss, for many years director of mechanical design and engineering for the American Radiator Co., Buffalo, and for the past 18 months assistant to the president, Richmond Radiator Co.. Uniontown, Pa., has resigned to enter the consulting engineering business and is located at Kenmore, N. Y.

Henry Banke has sold his interest in the Mattson Foundry Co., Eau Claire, Wis., to A. M. Mattson and now is associated with the C. A. Lawton Co., De Pere, Wis.

Giacomo Bargellesi, Ferrara, Italy, now is acting as consultant and technical secretary of the recently formed Grupp Fonderie, Milan, Italy.

W. O. McMahon, graduate chemist, and formerly connected with foundries in the South, has been added to the sales organization of Sloss-Sheffield Steel & Iron Co., Birmingham, Ala., to engage in consulting work. Y. A. Dyer has been appointed consulting engineer on cupola metallurgy and operation in connection with its sales organization.

William Dingeldein has been appointed manager of the Dundalk, Baltimore, plant of Central Foundry Co., New York, succeeding Alexander T. Drysdale, whose death was announced in the Aug. 1 issue of THE FOUNDRY. Mr. Dingeldein has been in the employ of the company for 18 years.

Thomas W. Evans, lately associated with the Pittsburgh Crucible Steel Co., Midland, Pa., as open hearth superintendent, has recently become connected with the Vulcan Mold & Iron Co., Latrobe, Pa., in the sales and service department. Formerly Mr. Evans was open hearth superintendent at the Toronto, O., plant of Follansbee Bros. Co., general superintendent of steel works at American Tube & Stamping Co., Bridgeport, Conn., and electric furnace and plant A open hearth superintendent of the United Alloys Steel Corp., Canton, O.

HYMAN BORNSTEIN

Changes Affiliation

Lynn B. McKnight, who for the past eight years was associated with the Dodge Mfg. Corp., Mishawaka, Ind., in various sales capacities, has been appointed sales manager of the Stearns Conveyor Co., Cleveland, manufacturers of belt conveyors and silo storage systems. Mr. McKnight was with the Dodge company from 1919 to 1921 at the home office in Mishawaka, and in 1921 was sent to the San Francisco office to take charge of the Pacific coast. In 1923 he was made sales manager of the Cleveland and Pittsburgh district. Mr. McKnight was graduated from the department of mechanical engineering, Purdue university, Lafayette, Ind., in 1915. The Stearns Conveyor Co. is owned by Chain Belt Co., Milwaukee.

Elect New Officers

Quad City Foundrymen's association has elected Hyman Bornstein, Deere & Co., Moline, Ill., as president and H. A. Deane, also with the Deere company as secretary-treasurer. The Tri-City Technical council has elected F. V. Skelley, Tri-City Railway Co., Rock Island, Ill., as chairman and Max Sklovsky, Deere & Co., Moline, Ill., as treasurer.

Gives Economic Report

The World Peace Foundation, 40 Mt. Vernon street, Boston, has published a memorandum on the iron and steel industry compiled by the International Economic conference held at Geneva, Switzerland, May 1927. This publication, sponsored by the League of Nations, gives figures of output and capacity, data on labor conditions, tariffs, exports and imports, consumption and prices. It may be obtained directly from the World Peace Foundation at the price of $1.

Announce Fall Plans

The officers and directors of the Detroit Foundrymen's association have announced a schedule of meetings for the fall to start with the September meeting which will be addressed by Arnold Lenz, Saginaw Products Co., Saginaw. Other features selected are as follows: October, nonferrous night with special program arranged by Vaughan Reid, City Pattern Works, Detroit; November, University of Michigan night with speakers from the department of engineering research; December, address by Frederic B. Stevens, Frederic B. Stevens, Inc. and J. D. Stoddard, Detroit Testing Laboratory.

In addition, the officers are planning to arrange for a dinner dance for the ladies during the month of February.

Obituary

H. O. Seymour, director of the Chain Belt Co., Milwaukee, died of heart failure July 23 at his country home, Lake Geneva, Wis. Mr. Seymour was a director of the Chain Belt Co., since 1918. He also was president of the First Wisconsin Trust Co., executive vice president of the First Wisconsin National bank, and vice president of the First Wisconsin Co., all of Milwaukee.

End Partnership

The firm of Page & Ludwick, operating a sales office at 14 East Jackson boulevard, Chicago, has terminated its partnership, according to announcement on Aug. 4. The business now is conducted at the same address by the Page Sales Service, representing the Milwaukee Electric Crane & Mfg. Corp., Thomas Flexible Coupling Co., Royer Foundry & Machine Co., the Magnetic Mfg. Co., and the H. D. Conkey Co.

Note Increased Sales

The Royer Foundry & Machine Co., Wilkes-Barre, Pa., reports increased sales of its sand separator equipment during July. Among purchasers were the following: Allis-Chalmers Mfg. Co., Bullock Works, Norwood, Ohio; Columbia Steel Corp., Portland, Oreg.; Dexter Folder Co., Pearl River, N. Y.; Holyoke Fdry. Co., Holyoke, Mass.; Mueller Co., Decatur, Ill.; A. Y. McDonald Mfg. Co., Dubuque, Iowa; Nickel Plate Fdry. Co., Cleveland; Norfolk Navy Yard, Portsmouth, Va.; Perfect Circle Co., New Castle, Ind.; Plessisville Fdry., Plessisville, Que., Canada; Rockwood Mfg. Co., Indianapolis; Snapp Foundry Co., Winchester, Va.; Standard Fdry. Co., Buffalo; Sully Brass Fdry., Ltd., Toronto, Canada. U. S. Radiator Corp., Corry, Pa.; University of Washington, Seattle.

To Hold Meeting

The fall meeting of the American Refractories Institute will be held September 15 at the Clifton hotel, Niagara Falls, Canada. Dorothy A. Texter, 2202 Oliver building, Pittsburgh, is secretary of the society.

H. L. Carpenter Jr., formerly salesman and buyer, and John A. Morrison, formerly purchasing agent, Ajax Metal Co., Philadelphia, have resigned from that firm and organized the Car-Mor Metal Co., Gaul and Gordon streets, Philadelphia. The new firm will produce and sell nonferrous metals.

Hold Molten Metal in Closed Ladle

That the heat losses from closed ladles in foundries are much less than from open ladles, has been proved by experiments conducted recently by the bureau of standards in co-operation with the American Foundrymen's association.

For many years it has been the practice in the iron and steel industries to transport molten metal from one location to another in open ladles. Recently a closed type ladle has been introduced which has the shape of a submarine and is mounted on trucks similar to those of a railway car. The only opening in this ladle is at the top and is about 3 feet in diameter so that the heat loss from the free surface is much less than from the open ladle. These ladles are made with capacities up to 150 tons.

It is important to know how long the metal in such a ladle will remain molten. Accordingly, the bureau of standards recently conducted a test for the American Foundrymen's association to determine the rate of cooling and the heat losses from a 75-ton, closed, car ladle. It was found that the molten iron in such a ladle cooled only about 11 degrees Fahr. per hour and with this rate of cooling it would be possible to hold a ladle of molten iron for 40 hours before it became too cold to be poured out.

Foundry Association Directory

American Foundrymen's Association

President, S. W. UTLEY, Detroit Steel Casting Co., Detroit; secretary-treasurer, C. E. HOYT, 140 South Dearborn street, Chicago; technical secretary, R. E. KENNEDY, 909 W. California street, Urbana, Ill.

The Buffalo Foundrymen
Buffalo

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings the third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, G. H. ROLINSON, American Brake Shoe & Foundry Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 W. Eighteenth street. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, Capitol Foundry Co., Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association
Detroit

President, J. J. BOLAND, Griffin Wheel Co., Detroit; secretary, ROBERT HOPE, Holley Carburetor Co., Detroit. Meetings third Thursday in each month at the Union League club, 35 Grand River avenue, Detroit.

East Bay Foundrymen's Association
Oakland, Calif.

Secretary, H. L. MARTIN, Marchant's Foundry Co., 4401 East Tenth street, Oakland, Calif.

Metropolitan Brass Founders' Association
New York

President, WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by President.

New England Foundrymen's Association

President, HENRY S. CHAFEE, Builders Iron Foundry, Providence, R. I.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio State Foundrymen's Association

President, WALTER L. SEELBACH, Walworth Run Foundry Co., 2488 West Twenty-seventh street, Cleveland; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenue, Cleveland.

Philadelphia Foundrymen's Association
Philadelphia

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary HOWARD EVANS, Union League club, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers club.

Southern Metal Trades Association
Atlanta, Ga.

President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Pittsburgh Foundrymen's Association
Pittsburgh

President, C. D. CAREY, American Steel Foundries, Pittsburgh; secretary-treasurer, WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association
Davenport, Iowa

President, HYMAN BORNSTEIN, Deere & Co., Moline, Ill; secretary-treasurer, H. A. DEANE, Deere & Co., Moline, Ill. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Tri-City Technical Council
Moline, Ill.

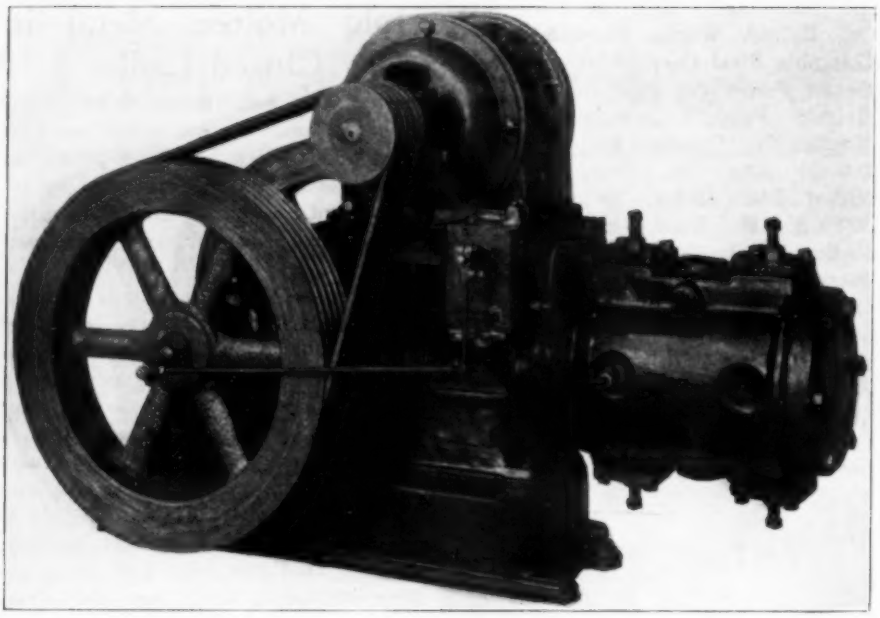
Chairman F. V. SKELLEY, Tri-City Railway Co., Rock Island, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
Cincinnati

President, HAROLD P. RITTER, John A. Oberhelman Foundry Co., 3323 Colerain avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association
Minneapolis-St. Paul

President, H. H. NOTT, Smith System Heating Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meetings monthly at the Athletic club.



THE DRIVING MOTOR MAY BE MOUNTED DIRECTLY ON THE COMPRESSOR FRAME WITH NEW MULTIPLE BELT DRIVE

Compressors Feature New Drive Principle

The Pennsylvania Pump & Compressor Co., Easton, Pa., has developed a horizontal, double acting air compressor which provides a belt drive unit permitting close spacing. The usual arrangement, where the motor is set ahead of the compressor, with an idler riding the top of the belt to provide the necessary tension and take-up, is not followed in this machine. The drive is a multiple belt, made by the Allis-Chalmers Mfg. Co., Milwaukee. It consists of a number of flexible, V-shaped rubber fabric belts, operating on grooved sheaves, in a manner similar to the English or separate rope drive. The motor may be set immediately ahead of and in the closest proximity to the frame of the compressor, or, where space requirements demand, the motor may be mounted directly on top of the compressor frame, as is shown in the accompanying illustration. No idler is employed.

Offers New Trailer

A steel trailer with rubber-tire wheels, complete bearing equipment, and fitted with an automatic coupler has been put in production by the Clark Tructractor Co., Battle Creek, Mich.

This trailer incorporates certain distinctive features in the way of rubber tires and automatic couplers which aid to increase safety of loads and speed of operation. It is the standard warehouse and shop size, with a diamond-plate, steel platform 3 x 6 feet, and the top of the platform is 14 inches from the ground. The body is formed by a single piece of ¼-inch diamond plate steel. The diamond surface is designed to prevent the load from slipping. Adjustable racks interchangeable for use on ends or sides are provided.

Casters swivel on eighteen, 1-inch steel balls with Timken bearings in the king pin location. Wheels are mounted on solid, roller-type bearings of special design. All bearings are equipped with pressure-oil fittings.

Rubber tires are furnished on all four wheels. The rear tires are 12 x 4 inches in size and the caster tires 10 x 3 inches. The weight of the complete trailer is 550 pounds or 25 pounds more than the conventional wooden trailer. The trailer may be coupled and uncoupled by the driver without dismounting.

Bubbles Form on Castings

Question—The casting for the leg of a stove to be enameled comes from the sand apparently sound, but when it is enameled small bubbles appear on the surface which is bowed out in the form of a hump and at the tip. Our chemist advises us that the iron is correct for enameling and it would appear so from the fact that no other casting gives trouble in enameling. The enameler advances the idea that the trouble is due to the castings being taken out of the mold in the evening and allowed to lay on the floor over night resting on the two points which show the bubbles. Parting and graphite facing are used sparingly on the mold. The face of the casting is molded in the drag.

Answer—From the limited details which you give we would judge the trouble is more apt to be due to the parting or graphite facing, more likely the latter, and would recommend that you try some castings without any graphite or facing, or with a different grade of facing, in the meantime having the present graphite and facing analyzed for sulphur. High sulphur in the facing would be apt to be absorbed by the casting and be given off during enameling.

Rubber tires and quick change coupling feature new trailer. Bearing equipment used.

Chicago Pneumatic Tool Co., New York, has removed its Seattle branch office, service department and warehouse from 119 Jackson street to 1743-47 First avenue, south, Seattle.

Permeability Needed in Radiator Cores

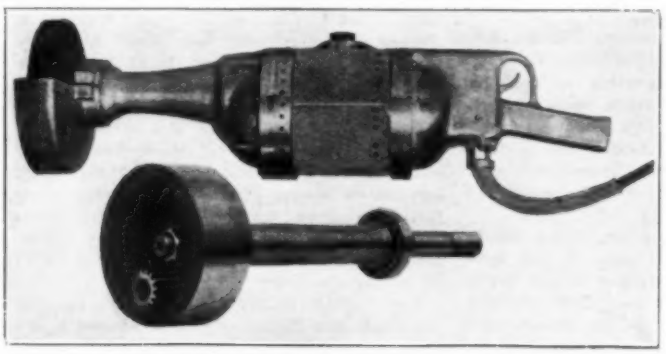
Question: Is there any substance which may be added to an oil sand core which will increase the green strength without impairing the permeability? Our radiator cores sag slightly after the box is removed and as a result the castings are over weight and occasionally a core shifts in the mold.

Answer: So far as we know radiator cores are made exclusively from sharp sand bonded with oil. Certainly that is the mixture used in several plants with which we are familiar. Strength and maximum permeability are two essential features in these cores, completely surrounded by iron with the exception of two vent holes, and it is difficult to secure one without the other. In an experimental way we suggest you add a small quantity of molding sand to your core mixture. The molding sand will give the green core a body and prevent it from sagging, but it will decrease the permeability. Only by experiment can you determine to what extent, if any, this feature may be lowered. Incidentally a coarser grade of sharp sand may be used in connection with molding sand. If you find that the core mixture cannot be changed, then apparently the only alternative is to increase the depth of the core box a trifle to anticipate the sag in the core.

Has Internal Gear

The Black & Decker Mfg. Co., Towson, Md., has made a number of changes in the design of its line of motor driven portable grinders. One of the features to be embodied in the 5 and 6-inch machines is an internal gear drive which reduces the distance between gear centers, and consequently reduces the diameter of the gear housing. The grinder, internal gear and the wheel spindle assembly are shown in the accompanying illustration. The internal gear is of sturdy construction to withstand severe service.

The wheel spindle is supported at each end by tapered roller bearings. Another feature of the machine is the location of the air intake holes. This method has been adopted to protect the motor windings from the sharp particles of grit which may be pulled through the motor with great velocity by the ventilating fan.



DISTANCE BETWEEN CENTERS IS REDUCED

Faked Foundry Facts

Looking Over the Scrap

Use 9-Inch Cupola

By A. J. Strong

Several interesting accounts of experiences with small, improvised cupolas have appeared in THE FOUNDRY and this one is offered as a possible addition to those which have gone before. Before the present standard cupola was installed at the engineering college, University of Florida, Gainesville, Fla., a 9-inch cupola was built which served fairly well, in the absence of better equipment, to demonstrate to students the operation of a cupola.

The shell of the cupola was made from a discarded 15-inch steel smoke stack. A fire box door frame from a portable engine boiler, obtained from a junk pile served as a bottom plate. This frame was nearly square with a drilled hole at each corner. Four legs made from 2-foot lengths of 2-inch flues attached by long bolts passed through a foundation plate up through the legs and through the drilled holes in the bottom plate made a rigid support for the shell.

The round fire door, about 1 foot in diameter, provided a fine drop bottom. The charging door was 7 feet above the bottom. A tuyere from an old hand forge was bolted to the shell 6 inches above the bottom and the forge fan driven by a small motor furnished the air. The fan speed was 3600 revolutions per minute. The breast opening was made large enough to get an arm through while making up the bottom. A runner spout was bolted on with stove bolts.

The lining, a mixture of clay, molding sand and fire clay with pieces of brick was rammed in between the shell and a wooden core made by tacking thin staves to circular headers. A good, hot fire burned out the core and thoroughly baked the lining.

During the first trial this cupola melted about half the charge and then became bridged so tightly that we were afraid to jar it loose until the apparatus cooled down. We afterward ran five quite successful heats with it putting 100-pound charges on top of the coke bed after the bed had been burning an hour and a half and then leveled up to about 2 feet above the bottom. Melted iron appeared at the tap hole from 7 to 10 minutes after starting the blower.

The lining was in rather bad shape after the fifth heat and the small size made repairing difficult so the 9-inch cupola was torn down to make room for other foundry equipment.

Appoint Representative

O. H. Davidson, formerly Pittsburgh district sales representative, Blair Engineering Co., New York, has been appointed special representative for the United States Refractories Co., Mt. Union, Pa.

In 1921 4.35 per cent of the fluorspar shipped from the mines in the United States was used in the foundry, and in 1925 the amount had risen to 5.52 per cent according to a bulletin on fluorspar issued by the bureau of mines.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Kay-Bruner Steel Casting Co., Glendale, Calif., has acquired a site and plans to build a new foundry at Alhambra, Calif.

Athens Stove Works, C. L. Williams manager, is enlarging its warehouse.

Holland Furnace Co., Holland, Mich., contemplates expansion of its present plant.

Mueller Brass Co., Port Huron, Mich., O. B. Mueller, president, will expand its plant.

Gilbert Mfg. Co., Aberdeen, S. D., has removed its plant and general offices to Stillwater, Minn.

Price-Pfister Brass Mfg. Co., 2922 Humboldt street, Los Angeles, will build a 1-story machine shop.

City Foundry Co., 4629 Hamilton avenue, Cleveland, is building a 2-story pattern storage building, 60 x 120 feet.

Fulton Drop Forge Co., Canal Fulton, O., will build a 2-story foundry replacing fire loss.

Ailing Iron Works, 217 O street, Sacremento, Calif., will build a 1-story shop and foundry, 40 x 60 feet.

Canton Foundry & Machine Co., 600 Third street, Canton, O., contemplates building an addition to its foundry and machine shop.

Central Radiator Co., Lansdale, Pa., will build a new plant 130 x 250 feet on the site of the present plant.

American Piston & Machine Co., Alpena, Mich., has been incorporated with $75,000 capital to manufacture pistons by Charles E. Stead, Alpena.

International Sheet Casting Co., Cleveland, has been incorporated with 500 shares no par value by Leo Paul, Louis Bloomfield and H. K. Mansfield.

Falls Electric Furnace Corp., Buffalo, has been incorporated with 100 shares no par value to manufacture metal goods by Herbert J. McCaulley, 660 Grant street.

Hood Mfg. Co., Tacoma, Wash., Earl S. Hood, 2922 Windom street, manager, has been organized to operate a foundry and machine shop.

Mcgquier & Jones Co., Portland, Me., manufacturer of iron and brass castings, is developing a new department for the manufacture of snow plows.

Chaplin-Fulton Mfg. Co., 36 Penn avenue, Pittsburgh, manufacturer of brass, bronze and other metal castings, has acquired adjoining property, 30 x 110 feet, for expansion.

Lynn Products Co., Lynn, Mass., has been incorporated with 1000 shares no par value to engage in foundry and machine shop business, by Ernest C. Leach, Lowell, Mass.

Commercial Foundry Co., 7823 Alabama street, St. Louis, has awarded the general contract for a 1-story foundry building 105 x 125 feet to Stupp Bros., Syndicate Trust building.

Frank Chyall, 4193 East 114th street, Cleveland, contemplates forming a company to manufacture gray iron castings and expects to be in the market shortly for foundry equipment.

Wisconsin Iron & Metal Co., 164 Marion street, Oshkosh, Wis., has awarded the general contract for its scrap warehouse and refining plant 60 x 105 feet, to Schoenrock Bros. Co., New London, Wis. (Noted June 15).

Summers Foundry Co., 1006 South Holmes avenue, Indianapolis, will build a 1-story foundry addition, 42 x 70 feet, and has awared the general contract to Hunter Realty Co., 1639 Woodlawn avenue.

V. K. Worthan Molding Co., 160 North Wells street, Chicago, has been incorporated with 200 shares no par value to manufacture machinery and devices by Richard P. Garrett, 30 North LaSalle street.

City of Boston is to build a 3-story high school on Greenwood street in which will be two machine shops and one pattern shop. McLaughlin & Burr, 88 Tremont street, are the architects.

Gray & Dudley Co., Nashville, Tenn., founder and manufacturer of stoves, has passed into control of Houston Dudley, for 25 years its manager. He has bought the interest of John M. Gray Jr., who is retiring.

Hannibal Car Wheel Foundry Co., Hannibal, Mo., has awarded the contract for a car factory at Southport, La., including a steel foundry, 200 x 200 feet and a machine and pattern shop, 43 x 104 feet, to Austin Co., 6112 Euclid avenue, Cleveland.

Milwaukee Woodwork & Pattern Co., Milwaukee, has been granted a charter and has a capital stock of $25,000. Incorporators are August and Fred Kornburger, 1371 Thirty-fourth street, Jilmer Boett, August Kloth and William Schlicht.

Hudson Brass Works Inc., Brooklyn, N. Y. and the Ross & Gade Co. Inc., New York, will be conducted as one unit under the firm name of Hudson Brass Works Inc. with headquarters at 12 Nassau street, Brooklyn, N. Y.

Mosher Steel & Machinery Co., Dallas, Tex., will start work soon on its new plant, to consist of 11 buildings, including structural iron works, ornamental iron works, iron and steel shop, machine shop etc. W. S. Mosher is president.

Oklahoma Steel Castings Co., Tulsa, Okla., recently incorporated, is planning to add 1500 square feet of floor space to its cleaning department, and to install new equipment, including an annealing oven. Later, the company will install automatic sand handling equipment. (Noted Aug. 1).

Hills-McCanna Co., Chicago, makers of nonferrous castings will be able shortly to occupy its new plant, work on which is far advanced. The plant is designed for production of the nonferrous mixtures in which this foundry specializes, in rough castings and finished parts. Chrome steel and iron and nickel castings also will be made.

Connecticut Electric Steel Co.'s plant at Hartford, Conn., which has been idle for several years has been leased by John D. Scott and will be put into operation at once in the manufacture of high grade steel castings. Mr. Scott recently has been conducting experimental work in the Krupp plant in Germany and claims to have developed new steel alloys. The plant operation will be started with 30 employes.

Sawyer-Massey Co., Hamilton, Ont., manufacturer of agricultural implements, has been taken over by new interests and a new board of directors has been elected. This includes T. A. Russell, president; R. H. Mulch, vice president; Chester Harris, Brantford, Ont., H. H. Champ, Hamilton, Ont., G. R. Cotterellee and J. H. Lash. T. B. Christie has been made general manager. Production is to be enlarged and broadened to include road-making machinery.

American Brass & Iron Co., 5736 Twelfth street, Detroit, is adding to its facilities by construction of a foundry and machine shop at 6500 Georgia avenue. The foundry will be 55 x 85 feet with reinforced concrete pattern and metal vault, coke storage and a basement for sand storage. A machine shop, office and shipping building is 80 x 110 feet, one story, designed for a second floor later. Its output is special brass castings for automotive, gas stove, cream separators, etc.

W. A. Riddell Co., Bucyrus, O., has been organized to take over the five plants formerly owned by the Hadfield-Penfield Steel Co., American Clay Machinery Co., and the Era Steel Co. The plants are located at Chicago, Cleveland, Mansfield, O., and Bucyrus. It is planned to concentrate the business at Bucyrus and eventually sell the plants in the other three cities. W. A. Riddell is president of the new company and M. O. Garner is vice president. The company will specialize in the manufacture of road-building and clay-working machinery and manganese steel castings.

New Trade Publications

COMBUSTION CONTROL—Leeds & Northrup Co., Philadelphia, has published a 24-page bulletin describing its automatic combustion control devices. These consist of air flow, furnace pressure, and fuel feed controllers; uptake damper, forced draft damper and speed controller drives, and fan speed controller drives. The switches and indicating instruments are mounted together on panels to promote easy regulation.

SCREENS—Link-Belt Co., Chicago, has published a 24-page bulletin describing its types of moving intake screens for water supplies. Features of operation and construction are given. Illustrations from installations show the application of the screens.

FOUNDRY SCHOOL—Wentworth Institute, Boston, has published a catalog giving an insight into its course in foundry practice. Illustrations from the various foundry shops are included as are letters from foundrymen and others commenting on the course.

PNEUMATIC TOOLS—Rotor Air Tool Co., Cleveland, which has taken over the pneumatic tool department of the Warner & Swasey Co., Cleveland, has issued a catalog of its grinders and drills. Illustrations show the tools in use and diagrams show construction.

OUTBOARD BEARINGS—Boston Gear Works Sales Co., Norfolk Downs, Mass., has released a circular on its adjustable outboard bearings for use as support for bearing shafts, countershaft hangers, temporary bearing for future adjustment gear mount and as pillow blocks. Diagrams and engineering data guide to choice of proper size.

SAW SHARPENERS—Machinery Co. of American, Big Rapids, Mich., has issued a bulletin covering several types of sharpeners designed for use in reconditioning circular saws.